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FEBRUARY 1944

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CONTENTS

Cover Illustration

Curtiss Commandos on the production line in a Buffalo plant of the Curtiss-Wright Corporation.

Articles

Meteorology in International Air Commerce . . . . . F. W. Reichelderfer 7

Requirements of Local Air Transport Service . . . . . Edward Warner 13

Industrial Training . . . . . Leonard Weiss, Peter Lubin, and Richard T. Everill 49

Reviews

Periodicals 65

Government Publications 149

Books 161

- **Tomorrow We Fly**
- **Brassey's Naval Annual 1943**
- **American Heroes of the War in the Air**
- **The Flight Testing of Production Aircraft**
- **Air Acrobatics Are Easy**
- **Flying the Weather**
- **Fundamentals for the Aircraft Mechanic**
- **Little Known Facts About the Air Transport Industry**
- **Navigation**
- **Aircraft Electrical Engineering**
- **Airplane Performance and Operation**

House Organs and Catalogues 179

From the Industry 187

General

Source Material 143

Institute News 205

Twelfth Annual Meeting—Final Program 217

Appreciation to Corporate Members 219

Index to Advertisers 221

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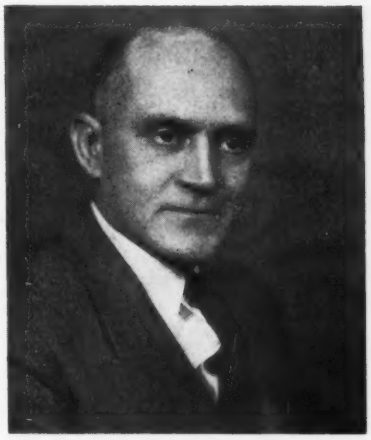
Meteorology in International Air Commerce

F. W. REICHELDERFER*

United States Weather Bureau



SUMMARY

In every air transport operation the state of the atmosphere—that is, the weather—is a factor. Atmospheric pressure, temperature, wind, and even humidity enter into aircraft performance. Sometimes, they affect air safety. In earlier days weather information was needed *primarily* for safety. Now it is a factor of increasing importance in pay loads, performance, schedules, and overall operating efficiency. Weather information shows the pilot and the operator how to make best use of existing conditions. For this purpose certain meteorologic facilities are necessary. Examination of the subject in relation to international air commerce shows several general requirements. These are described in this paper.

EVOLUTION OF WEATHER SERVICE IN AIR TRANSPORTATION

THE AIRWAYS meteorologic organization in the United States is the outcome of necessity. It represents today what experience in air transport has found essential for efficiency and safety. The basis of modern weather service is a world-wide system of meteorologic stations that make frequent reports of weather observations to designated centers where weather maps are drawn several times daily and constant watch is maintained over the ceaseless changes in the atmosphere. In this country the meteorologic organization has developed two supplementary but somewhat distinct methods of operation and application. These may be called (1) the "spot weather" method and (2) the synoptic weather method. The two usually operate more or less as a single system, and in many instances a given report or station serves both methods or purposes. Often the distinction is little more than a difference in interpretation or point of view, but in a review of how the system evolved the difference is important.

When modern weather services began several decades ago, the synoptic weather reporting stations were few and far between. Reports were only sufficient to draw a general weather map and were not closely spaced or frequent enough to give the detailed information and the more specific forecasts required for aviation. Pilots found the general forecasts inadequate and often did not trust them. They turned naturally to the spot weather report as something definite and factual; an actual observation as distinguished from a forecast or an opinion, however expert. The first full-scale experimental airways weather service was built around frequent spot weather reports as a step toward greater accuracy in weather information. But even in this service there is an element of forecasting because it assumes that the spot weather condition will prevail until the plane arrives at the reporting station. This assumption was usually correct when flights were short, but, despite its momentary accuracy, the spot weather report is far from adequate and has serious disadvantages. It does not always warn against sudden changes in weather; it often fails to disclose bad weather between stations and it does not in itself give the information required in forecasting the weather for extended trips and for planning scheduled operation hours or days in advance. It implicitly assumes that meteorologic features are more or less permanent and stationary like the mountains and plains on a topographic chart, and it tends to overlook the complex and sometimes dynamic changes that go on unceasingly in the atmosphere. The free air is never really static and it is impossible to set up a spot weather system that would give reports with such frequency and from sufficient stations to keep up with the changes in weather in the many localities where air transport and other activities are concerned. The purpose is accomplished in another manner. The spot weather report is essential, however, as an up-to-the-minute local observation for immediate air traffic control, for take-off and landing, and for confirmation or correction of the weather analysis and forecast when conditions are changing rapidly.

The Synoptic Weather Report

The synoptic weather report, as distinguished from the spot weather report, is designed primarily for use in drawing weather maps used by the meteorologist to analyze the situation and forecast the trends and new developments in atmospheric conditions. It goes beyond the limitations of the spot weather report and makes it possible to describe and forecast the weather at many places from which reports are not received. Essentially, the synoptic system makes use of a network of reporting stations selected so as to be representative of conditions in the general area in which each station is situated. Systematic reports of significant weather elements are collected by wire or radio several times daily. These furnish a representative "sampling" of the atmosphere over the continent, the hemisphere, or the globe and give the meteorologist the data he needs to analyze the air-mass situation, determine the immediate causes of existing weather conditions everywhere over the region, and estimate the future weather developments. In other words, by interpolation in space he determines the conditions in areas between reporting stations, and by extrapolation with respect to time he *forecasts* the weather in the near future. To some extent also, he can extrapolate beyond the boundaries of his map and give certain information about the meteorologic situation in contiguous areas.

Synoptic reports and weather maps are indispensable in briefing the pilot on the changes in weather during extended trips and in other phases of aviation weather service. They are the only practical approach to weather information for operations over oceans and barren or undeveloped continental regions where frequent spot reports are not obtainable and only a meager sampling of weather conditions is available from the widely scattered reports of designated ocean ship observers or regular synoptic stations.

The network of observing stations and ships was gradually extended over land and sea until reasonably adequate weather information was available over many regions before war broke out, but this network will have to be greatly amplified and extended to meet the future needs of air commerce. The requirements cannot be stated in detail now, but they can be indicated in a general way.

AIR TRANSPORT REQUIREMENTS IN METEOROLOGY

Without going into the technical aspects of meteorology the weather information commonly of interest in air operations may be divided into, first, *local* landing conditions at regular airports and, second, *general* upper air or in-flight weather conditions.

The local airport requirement that includes all of the usual information for take-off, landing, and air traffic control

Presented at the Air Transport Meeting, I.A.S., Washington, D.C., October 26, 1943.

* Chief.

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in the vicinity has its own detailed problems such as that of satisfactory, continuous measurements of cloud ceilings and visibilities, but it creates no difficulties that are peculiar in its relation to international air commerce. Every improved airport with navigational aids and landing facilities is or can easily be equipped with the standard meteorologic instruments that give barometric readings for altimeter settings, cloud heights and visibilities for the aircraft approaches, wind directions and velocities for take-offs and landings, and other local weather observations needed under some circumstances. These are readily obtained with the equipment that forms a regular part of airport installations.

The second requirement, in-flight weather conditions for an extended trip, is the subject that needs attention. This includes wind information at flying levels for use in computing fuel requirements, pay load, etc., and information of special conditions that may necessitate changes in altitude or route—for example, cloud layers that call for instrument flying or cause ice accretion on aircraft and points or zones of excessive turbulence in severe thunderstorms and local tornadic disturbances. These conditions may be experienced en route, and unless their existence or development is known beforehand they may adversely affect operating efficiency and even involve safety of aircraft.

Importance of Weather Phenomena

Some of the weather phenomena just mentioned are of interest primarily in connection with operating efficiency, others relate primarily to safety, and practically all involve both these interests to greater or less extent under special circumstances. The relative importance of each and its application to the individual case are aspects best left to the pilot, operator, or controller directly concerned. The question is how can accurate information of significant meteorologic conditions on extended flights be obtained and what reports and facilities must the meteorologist have in order to give reliable forecasts.

It may be pointed out here that the meteorologist is often expected to perform the impossible. His science is not occult. Like other physical sciences, it utilizes physical principles and requires certain basic data in order to produce sound results. The meteorologist cannot, for example, tell from a single local observation what is happening in the weather of a remote region, although he may often extrapolate with reasonable accuracy for a considerable distance if his local observation is a complete sounding of the air from the ground to a high altitude. Meteorology takes the representative samples of weather conditions given in synoptic reports; studies their interrelations, their trends, and the factors that make for further change with space (3 dimensional) and time; and gives a fairly accurate estimate or forecast of conditions not available in direct observations. The more detailed and representative the observations at hand in the form of synoptic reports, the more accurate the answer that the meteorologist can give. Certain phenomena such as general gales and hurricanes can be recognized and described with relatively few reports; others such as violent local thunderstorms can be intercepted with certainty only by a closely spaced network of reporting stations. The conditions that lead to development of these storms can usually be recognized in a general area by study of the weather map analysis, but the exact time and place of occurrence are difficult and often impossible to tell from observations of the normal station network. Although the mechanism of the atmosphere as a whole is more or less interrelated, it is not in the fixed manner of a train of gears in which the position of one element determines the positions of the others. In different instances the same general atmospheric situation, apparently identical as far as the broad-scale analysis shows and practically identical in many localities, may be greatly different in other details—for example, in the icing or turbulent portions which may occur in quite different localities.

Analyzing Weather Situations

An examination of the typical parameters of critical atmospheric disturbances gives an idea of the network spacing necessary to give representative observations and a correct analysis of the weather situation. Thus, general storms and gales, which are large-scale weather phenomena usually many thousands of square miles in extent at any one time and sometimes several hundred thousand square miles, can be located from relatively few synoptic reports. Wind observations at flying levels can be obtained in three or four ways—pilot balloon soundings, radiosondes (directly by ranging or indirectly from pressure data), and aircraft drift readings. For preparation of flight plans and for navigational purposes, wind conditions at flying levels can usually be analyzed and reliably forecast if the network has a pilot balloon station for every 25–30,000 sq. miles of territory. For adequate coverage all over the globe, between 5,000 and 10,000 such stations would be called for, but practical considerations such as the impossibility of maintaining this network at sea and in polar regions would reduce the number. For undeveloped regions and at sea, perhaps an average of one station for winds aloft for each 100,000 sq. miles would constitute an ambitious program but this is close to and at times below the minimum for giving adequate information of winds at flying levels. With fewer than this the safety factor that must be carried in fuel load makes for inefficient operation, or alternatively, the risks eventually lead to loss from unexpected head winds. In well-populated countries where a larger number of stations can be maintained they should approach the average of one station for each 25,000 sq. miles, which is approximately the density of observations of winds aloft found necessary in the United States for efficient and safe air transportation.

Reporting of Limited Storms

The foregoing comments refer to the network of stations for observations of winds at flying levels. This item has been placed first because air transport representatives interested in transocean and other long-haul operations believe that if they have accurate information of wind to be expected en route and reports of landing conditions at terminal airports they can operate in any kind of weather. They would fly through, around, or above other unfavorable conditions, these normally being more limited in extent than areas of general gales. Transocean flying is not simply a matter of avoiding strong head winds, however. There are local squall winds and other destructive weather conditions, clouds that cause rapid ice accretions on aircraft, thunderstorms, and tornadoes with extreme turbulence and wind shear, and it is important to know of and plan for these conditions in advance. It is not always possible for the pilot to recognize and avoid them when he encounters them unexpectedly in flight. The station network for observing winds aloft is not sufficient to discover all severe storms. Many are of limited extent and, as implied in the remarks on spot weather reports, a prohibitive number of weather stations would be required to locate and report immediately every local storm that brings risk of serious damage. The most destructive storm known, the tornado, often covers only a fraction of a square mile at any moment, yet it wrecks the strongest structures. It occurs usually in connection with low clouds and bad weather which prevent its being observed more than a mile or two away; it passes a given point in a few seconds and its destructive path is sometimes only a few hundred yards long. A system for reporting such storms would require a station every few miles, a total of more than 50,000 stations for the portions of the United States where these storms occasionally occur. They sometimes develop so quickly that they are past before warnings based on direct observation could be broadcast. Although destructive storms occur infrequently in any one locality and never in some regions, they do occur frequently and, in fact, daily in one place or another of the globe, and it is necessary to know these places in order to avoid them. Similar comments apply to those limited cloud layers and zones of poor visibility which necessitate changes in flight plans and routes. A more practical means than the spot weather report is needed to foresee the development and general location of these unfavorable conditions. Weather-map analysis and forecasting are the best alternative yet devised for this purpose with storms too limited in extent for direct observation.

The ideal synoptic weather network for obtaining reports for weather-map analysis would have facilities for com-

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plete surface and upper-air observations at intervals sufficiently small in time and distance to give a continuous and detailed analysis of significant atmospheric conditions. It is estimated that this might call for 600 complete synoptic stations for the United States and more than 25,000 for the globe as a whole—one for every 5,000 sq. miles, approximately, in most regions. In the United States the number of stations for synoptic observations at the ground now approaches this density. But the number of stations for upper-air soundings, particularly radiosondes, is much less because of the greater cost of operation of this type of station. The network found necessary in this country is probably the minimum goal for planning airways weather service in other regions concerned with international air commerce in appreciable volume. That is, the plan should provide for a surface synoptic station for each 5,000 sq. miles, approximately; a pilot balloon (winds aloft) station for each 25,000 sq. miles, as stated in preceding paragraphs; and a radiosonde station for each 50,000 sq. miles. The three purposes—surface observations, winds aloft, and radiosonde observations—are combined in one station whenever practicable.

Pilot's Reports

Where facilities for upper-air observations cannot be set up, surface observations must serve as a substitute. Sometimes an increase in the number of surface stations is a fairly satisfactory substitute for some of the missing aerologic (upper-air) stations. There is another substitute that can be utilized much more fully than it has been up to the present. This is the weather observation of the pilot or the navigator on scheduled trips, especially over sea—the in-flight or the postflight report. Although this type of observation cannot give as complete soundings of the atmosphere as a regular aerologic station, the profile view of weather over long distances which it can provide is useful in weather-map analysis, particularly if reports of cloud forms are included. Clouds in many cases write the life history of air masses and reveal much of importance in weather-map analysis. In-flight reports for aviation weather service are analogous to the surface vessel reports, which for years have been the foundation of meteorologic service for ships at sea. They can be organized to serve the common good and in large measure fill the gaps in weather information for flying over regions where neither the ideal nor the safe minimum in network of regular weather stations is immediately attainable. A well-organized system combining the weather information from these several sources will give enough observations for the meteorologist to draw a reasonably complete weather map and arrive at an analysis essentially accurate and sound as a basis for forecasting weather developments of interest in air transportation. These forecasts would include information of icing conditions in clouds, air-mass situations conducive to extreme turbulence, and other significant weather conditions such as those mentioned in relation to efficiency and safety in air operations.

Basic Organization

The work of the meteorologic organization in connection with operation of the aviation weather service under consideration here may be divided into two steps or stages. First is the function of operating the basic network of synoptic weather observations. It includes the operations of observing, recording, reporting, collecting, and analyzing the data in the form of daily weather maps and upper-air charts. Second is the interpretation of the maps and charts, their use in the preparation of forecasts, and the application of the information to individual plans and operations. In the many widely diversified fields of business, commerce, industry, and transportation the uses of weather information and forecasts and the advices relating thereto are numerous and varied. The first is inherently a government function like the postal service; the second is both governmental and individual or private in character. Decision as to which character predominates is dependent upon the nature of the particular case.

Operation of the Basic Network

With reference to the first stage—operation of the basic network—the ideal organization from the point of view of meteorologic science is an international system with observing stations and collecting centers wherever required for adequate weather analysis and with all instruments, readings, and methods coordinated through uniform standards and practices. This system would theoretically remove the errors that result from differences in instrumentation and interpretation and would lay foundation for the best meteorologic services for all purposes. Only one station for synoptic observations is required in any one place; duplicate stations and systems are wasteful of time, personnel, and communication channels and, unless their reports are identical, they are likely to cause confusion. Stations that duplicate can be put to better use if placed where there are gaps in the network and where observations would serve the common good of all interests. One complete integrated network of basic observations provides authentic data for weather maps for all purposes.

Weather-Map Interpretation and Forecasting

The second stage, weather-map interpretation and forecasting, has manifold applications and may be practiced by many individuals in the same locality for private use without necessarily causing wasteful duplication. In some countries where government ownership of public services and utilities is accepted, the meteorologic function is exclusively an activity of the government. In the United States where private enterprise enjoys certain prerogatives, air carriers and other business organizations may have their own meteorologists to interpret the weather map and give exclusive attention to company meteorologic interests. The public service of the Weather Bureau in its capacity as the official meteorologic agency is available for use of all interests. Special reports and forecasts are provided to whatever extent is possible with authorized Weather Bureau facilities. Private interests that desire supplementary or special services beyond the scope of those facilities may obtain them through their own use of 8 basic data or weather maps prepared by the Weather Bureau. Although the private practice of weather forecasting is primarily a private matter, there is an element of public responsibility because the basic synoptic reports and maps essential to the private practice of meteorology are provided by the Weather Bureau at public expense in the public interest. Government is concerned if these official reports are used in ways inimical to the common good or if private practice prevents full use of Government meteorologic service in safeguarding air transportation and other activities in which the public has a common interest.

The status of the air carrier meteorologist in the United States parallels that of the company dispatcher. The responsibilities of private ownership, private operation, and dispatching carry also a degree of responsibility for meteorologic decisions. If the company prefers to meet that responsibility through its own special meteorologic staff which it employs to amplify and supplement the government weather service, the Weather Bureau collaborates to make that practice possible. At the same time public policy requires that the Bureau provide general airways meteorologic service, including forecasts for common use by the carriers and the public. The policy with respect to this second stage or aspect of meteorologic organization—i.e., weather forecasting—differs somewhat in various countries in accordance with differences in economic and political views.

Communications

Modern weather service is impossible without efficient communications. Weather reports are "perishable"—that is, for current use they must be delivered immediately and, except for subsequent climatologic uses, their value decreases rapidly if they are delayed. These remarks refer to their application in drawing the daily weather map. The map must meet strict deadlines. Reports are lost for the daily map unless they are collected promptly from far and wide. It is not necessary to consider meteorologic communications facilities in detail here. It is sufficient to point out that this is a basic requirement of weather service. It is a major project calling for closest coordination among communications agen-

(*Continued on page 159*)

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Requirements of Local Air Transport Service

EDWARD WARNER*

Civil Aeronautics Board

IN ALMOST ALL DISCUSSIONS of the future of air transportation the development of local service, or "feeder service" as it is often called, now plays a large part. Much of the talk of such service has been in general terms, uncritical and unspecific. Within the past few months, however, a substantial number of serious studies of the possibilities of local operation have begun to accumulate. The Civil Aeronautics Board has been conducting formal hearings as a vehicle for the presentation of such studies;† and a considerable number of analyses have been presented by Government officials, by aircraft manufacturers, and by air lines, both actually in being and potential. All this material will repay careful study by students of the principles of air transportation and by the members of the aeronautical industry, as well as by the members of the Board and their associates who now have it in hand. The Institute's meeting today provides another channel, of which I have been glad to take personal advantage, for adding to the general stock of information, analysis, and opinion bearing on the scope of local transportation's prospects, and upon the ways in which they can be most largely realized.

SCOPE OF DEVELOPMENT

The problem of scope is fundamental. The amount of special development work that the industry can devote to specialized equipment will obviously depend upon whether there is a reasonable prospect of selling 100 of the specially developed aircraft, 1,000 or 10,000. The prospective economy of operation of local lines will be largely dependent on the prospective volume of service. The value of short-range air transportation as a public service and the confidence with which the ordinary citizen can look to it to solve his problems of personal mobility will in turn depend upon the extent of the transportation system that it proves economically possible to maintain—upon the closeness of the meshing of the ultimate air transport network and upon the frequency with which its various sectors are spanned by scheduled movements.

So far as I am to venture prophecy on any of these matters, let me approach it by way of examination of a few particular concepts.

FEEDER SERVICE

The first point of general examination relates to the practice, still widespread though somewhat less prevalent than a couple of years ago, of referring to all local operation as "feeder" service. The implication is that it is the primary role of local operation to collect and distribute passengers, mail, and express that will be interchanged with a through operation at a convenient connecting point. The implication is misleading; for the cases in which that class of traffic is predominant, at least so far as passengers are concerned, will in fact be the abnormal rather than the typical ones.

A true feeder service would be one that radiates out from a major air-line terminal to points within 30 or 40 miles. As the distance gets beyond that general range, local traffic between the local points and the metropolis becomes increasingly important, and finally predominant, with the feeding role receding correspondingly.

A few examples from existing experience will illustrate the point. Galveston is only 38 miles from Houston; yet in September, 1940, the month of the last complete Civil Aeronautics Board traffic survey, out of a total of 281 passengers originating or terminating in Galveston, 142, or 51 per cent, were local travelers between Galveston and Houston only. Other pertinent instances, with data drawn from the same survey, are shown in Table 1.

The proportion of purely local travel is still high, even in many cases where the same air line that renders the local service also goes on to points beyond so that passengers are able to travel through the "point of potential interchange" to other metropolitan centers without even changing to another plane. Galveston–Houston, Vancouver–Seattle, San Diego–Los Angeles, and Hartford–New York are examples.

The short-haul passenger is important and will remain so. His relative importance is likely to increase to above the level of present experience as shown by Table 1. The proportion of truly local traffic will, of course, vary in individual cases with a variety of local conditions, and in particular with the accessibility of the airport at the metropolitan center, and with the number and variety of the connections that can be made there for other routes; but, in general, local service has been, and will remain, much more than the title "feeder service" will properly cover.

LOCAL SERVICES IN BEING

The second of the general notes is that local service is not a wholly unfamiliar undertaking. To a modest extent, but still in an appreciable measure, it finds a place on the existing map of routes already certificated. We need not depend entirely on speculation. We have some experience upon which to draw.

There is no natural severance between local and nonlocal service, and any line that we draw to separate the two will have to be an arbitrary one. We may need such a line for certain purposes, technical or economical or both, but I shall not attempt to fix its location at the moment. Let me rather define local service in general terms, as being the conduct of scheduled air transport operations over a route on which stops are relatively closely spaced and on which most of the intermediate points, at least (and possibly one or both of the termini as well), are communities of less than the first magnitude. Table 2 shows a number of existing routes to fit that definition —especially its first part relating to interstop distance.

In at least one case substantially a whole existing system comes within the terms of the definition given, as shown by the comparative figures in Table 3.

Routes established with particular reference to the furnishing of local service may assume any one of several distinct forms. They may operate either:

Presented at the Air Transport Meeting, I.A.S., Washington, D.C., October 26, 1943.

* Vice-Chairman.

† Local-Feeder-Pickup Investigation, CAB Docket 827. Hearings began on September 28, 1943.

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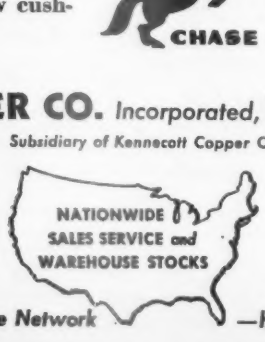

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TABLE 1

Local Point	Metropolitan Point or Point of Potential Interchange	Intercity Distance	Number of Passengers Originating or Terminating at Local Point*	Number Making Only a Local Trip Between Two Cities Named	Percentage of Local Passengers
Long Beach	Los Angeles	29	114	12	11
Akron	Cleveland	32	1,432	111	8
Galveston	Houston	38	281	142	51
Manchester, N.H.	Boston	44	96	54	56
Providence	Boston	49	181	165	91
Flint	Detroit	54	175	54	31
Colorado Springs	Denver	66	90	67	74
South Bend	Chicago	74	152	74	49
Milwaukee	Chicago	82	381	247	65
Santa Barbara	Los Angeles	85	114	86	75
Hartford	New York	92	2,124	1,064	50
Portland, Me.	Boston	96	976	559	57
San Diego	Los Angeles	122	2,106	1,459	69
Vancouver	Seattle	122	344	197	57
Grand Rapids	Chicago	132	760	685	90

* In cases in which an air route ran through the local point or in which that point was served by more than one route, only the passengers actually moving to or from the local point over the sector connecting it with the point of potential interchange are included. Thus, in the case of Milwaukee, the figure given for the total number of passengers includes only those moving between Milwaukee and Chicago or between Milwaukee and more remote points reached by way of Chicago. It excludes those moving over the Milwaukee-Madison or Milwaukee-Twin Cities sectors.

TABLE 2

Terminal Points	Length of Route	Number of Certificated Intermediate Points	Average Distance Between Consecutive Points	Populations of Terminal Points*		Population of Largest Intermediate Point*	Average Population of Intermediate Points*
Boston–Caribou, Me.	384	8	43	2,673,100	42,900	161,100	62,200
Boston–Montreal	264	5	44	2,673,100	1,360,000	207,600	104,000
Detroit–Chicago (by way of Battle Creek, etc.)	261	5	44	2,110,700	4,384,000	312,200	144,000
Detroit – Sault Ste. Marie	347	4	69	2,110,700	19,800	264,900	138,000
Norfolk – Knoxville	473	6	68	333,500	242,300	219,400	147,000
Jacksonville–Miami (by way of Tampa)	445	7	56	166,100	154,800	201,700†	66,000
Denver–Wichita	524	6	75	372,000	171,900	66,000	38,000
Salt Lake City–Lethbridge	687	8	76	218,500	25,000	74,300	34,000

* All populations given are totals resident within a 25-mile radius about the center of the point primarily served, except that where two points are within 50 miles of one another the common chord of the two overlapping circles of 25-mile radius is drawn and is then taken as a part of boundary of each of the two areas concerned, so avoiding any duplication of population count.

† St. Petersburg and Tampa together.

TABLE 3

Carrier	Revenue Miles Flown in September, 1940	Total Number of Individual Point-to-Point Flights Made	Average Length of Flight (Average Distance Between Landings)
United	2,238,300	10,460	214
T.W.A.	1,557,300	5,861	266
Northeast	97,100	1,845	53

(1) Radially from a traffic center to a series of points, with no opposite terminus of any great consequence in traffic generation.

(2) As a loop, with each flight both originating and terminating at a single major center.

(3) Between termini both of which are of substantial significance, and both of which may provide connections with other routes, but which do not provide enough through traffic to support a regular service of reasonable frequency without the help of the traffic originating or terminating at the intermediate points.

(4) Between major terminals already connected by so dense a flow of through traffic as to support an adequate service without reference to intermediate points, thus permitting the local operation serving intermediate points to be considered as superposed on the through or nonstop service and in some degree independent of it.

No one of these types is "best." The population distribution, existing transportation facilities, terrain, and economic geography of the particular route will determine into which category it is to fall; but something may be said of their several special characteristics and special merits and limitations.

The Radial Route

The radial route serving a multiplicity of points, with only one major terminus, bears one grave economic handicap. Since a major proportion of the traffic on such a route will ordinarily be between the several intermediate points on the route and the major terminus, or between the intermediate points and points beyond the terminus and reached by interchange there, and only a relatively small part between one intermediate point and another, the characteristic pattern will be one of progressively diminishing load on the outward-bound trip from the principal terminal and progressively accumulating load on the return. The condition of progressive variation is as unfavorable as can be imagined for realization of a high load factor. If the maximum average load factor that can be attained on the first segment of the route without risking the necessity of turning away any considerable number of applicants for space is 75 per cent, the corresponding factor on the last sector may have dropped to 30 per cent or less and the average to the order of 50. Where, on the other hand, there are two terminals possessing substantially equal attraction for traffic, the passengers outward bound from one of those terminals may be replaced as they disembark at the various intermediate points by newcomers taking passage for the opposite terminus. The point is almost too obvious in general terms to need explanation; and it is statistically supported by studies of the variation of average load over a few representative routes, some of them radial and some of the two-major-terminal type, in September, 1940 (see Table 4). Unfortunately I had to take examples that are not really in the local-route class to illustrate the case of intermediate points between two major terminals, as Norfolk-Knoxville was not operating at the time of the traffic survey and on the Detroit-Chicago route actual service was being rendered to only two of the five intermediate points.

TABLE 4

Termini	Average Number of Passengers per Flight on Successive Sectors, Starting from Terminal First Named	Ratio of Maximum Average Sector Load to Minimum
Boston–Caribou	6.5*—5.9—5.2—4.1—3.6*—2.1—1.6—1.0	6.5
Detroit – Sault Ste. Marie	7.6*—6.8—5.3—2.95	2.6
Boston–Montreal	6.6—6.3—5.6—4.8—2.7	2.4
Salt Lake City–Great Falls	6.0—5.7—5.2—4.8—4.0—3.1	1.9
New York–Washington (via Philadelphia and Baltimore)	10.2—9.5—7.8	1.3
Los Angeles – San Francisco (via Bakersfield and Fresno)	10.2—9.5—9.9	1.1
Los Angeles – San Francisco (via Santa Barbara and Monterey)	7.4—8.1—8.0	1.1

* Number of schedules reduced at this point for the purpose of keeping the variation of average load less than it would have been if all flights had gone straight through.

Despite the handicaps of a radial route with only one major terminus, there are cases in which it affords the only possible means of rendering any service at all. In northern New England and eastern Canada, for example, there is no possible terminal point that would have a pulling power on the traffic generated at intermediate points in that area even remotely approaching the attraction of Boston. All services designed to serve a commuting public, too, are by definition in the radial category. Obviously, in such cases, there is no possibility of finding an opposite terminal comparable in attraction with the metropolis to and from which the commuters make their daily journey.

The commuting flight that picks up traffic at several points will start with a minimum load, and progressively increase it as the destination is approached. That is, of course, as true of rail service as of air service, perhaps even more so; but the economics of railroading are more elastic than those of air transport with respect to load factor. The air line must reckon on a reasonably high average load factor (certainly in the neighborhood of 60 per cent) to make both ends meet. Railroad rates and expectations, on the other hand, are adjusted in normal times to considerable amounts of operation with cars less than half full.† Also the load factor itself is more flexible. There is no absolute maximum limit on carrying capacity, and occasional extraordinarily heavy loads can be cared for by allowing passengers to stand in the aisles, whereas the air lines must anticipate having a number of seats that at least closely approaches the absolute peak demand.

† In the years immediately before the war the average number of passengers carried in each car in all passenger train operations within the United States was only about eight.

Load Variation

The drawbacks of progressive variation of load can be reduced or even entirely overcome if individual points along the route supply enough traffic to connect them with the terminal by flights that will pick up only one or two or three points each, passing over the others nonstop. In rush-hour commuting it may be hoped that most pickup points will supply enough travelers to allow operation of individual aircraft nonstop from each point to the terminal. The operation of nonstop service from each point or small group of points also permits a great saving of time from the outermost points; but the farther such a subdivision of operation is carried, the smaller the aircraft that will have to be used, with resultant economic difficulties. Some of these matters will be developed in more detail in subsequent sections of the paper.

Loop-shaped routes encounter the handicaps of the straight radial line in milder form, since there is a gradual transition from the outward-bound to the inward-bound flight, and passengers headed for the terminal points will begin to board the airplane at intermediate points preceding those at which the last of the outward-bound passengers will have been dropped.

The remaining possibilities, listed as (3) and (4) in my initial tabulation, both correspond to the operation of a route connecting two terminals, both of substantial significance, by way of a number of closely spaced intermediate points. It is a case that is represented by several examples in the tabulation that I have made of load variation along various existing routes (Table 2), and it seems likely to be a common case for the future, if not indeed the generally prevailing one.

The ideal condition for load distribution is that of a local service touching a string of intermediate points between two terminals of substantially equal importance and not more than 200 or 300 miles apart. In this, as in other matters, the ideal seldom exists.

TRAVEL BY THROUGH AND LOCAL SCHEDULES

The distinction between the two alternatives in this general group is based on the amount of service that could be supported by through traffic. It seems obvious that through passengers, given a reasonable choice between a nonstop service and one making intermediate stops, the two flights leaving nearly at the same time, would prefer the nonstop alternative. It seems equally certain that if there were only two schedules a day, one nonstop and the other with intermediate stops,

TABLE 5

	New York–Washington	Boston–New York	San Francisco–Los Angeles	Chicago–Twin Cities
Number of nonstop flights per day (in each direction in September, 1940)	25.5	12.0	7.0	4.0
Number of flights per day with intermediate stops				
1 stop	8.0	7.5		0.5
2 stops	5.0	1.5	5.0	1.5
3 stops				1.0
Percent of total number of schedules operating with intermediate stops	*33.8*	*42.9*	*41.7*	*42.9*
Average number of through passengers per day between terminals or points beyond	794.5	645.9	422.3	173.8
Number of such passengers traveling on schedules making intermediate stops	182.3	210.9	85.2	56.6
Percentage of total number of through travelers using schedules making intermediate stops	*22.9*	*32.6*	*20.2*	*32.6*
Percentage of travelers on local-stop schedules who were going at least from one route terminal to the other	69.2	65.3	74.4	63.1
Ratio of number of through passengers carried on each nonstop schedule to number of through passengers on each local schedule	1.68	1.55	2.83	1.55

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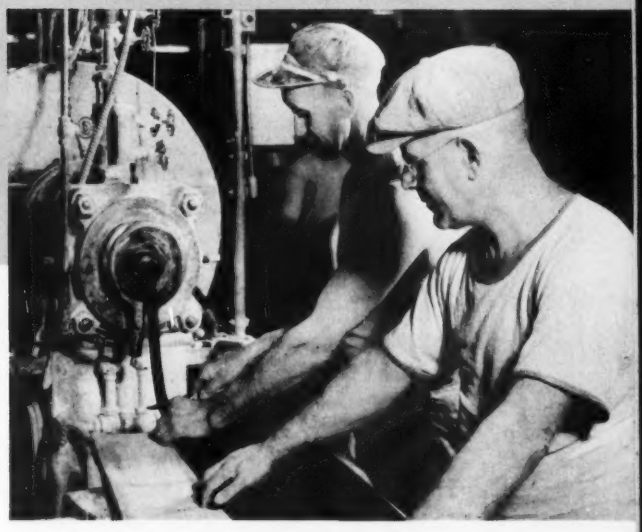

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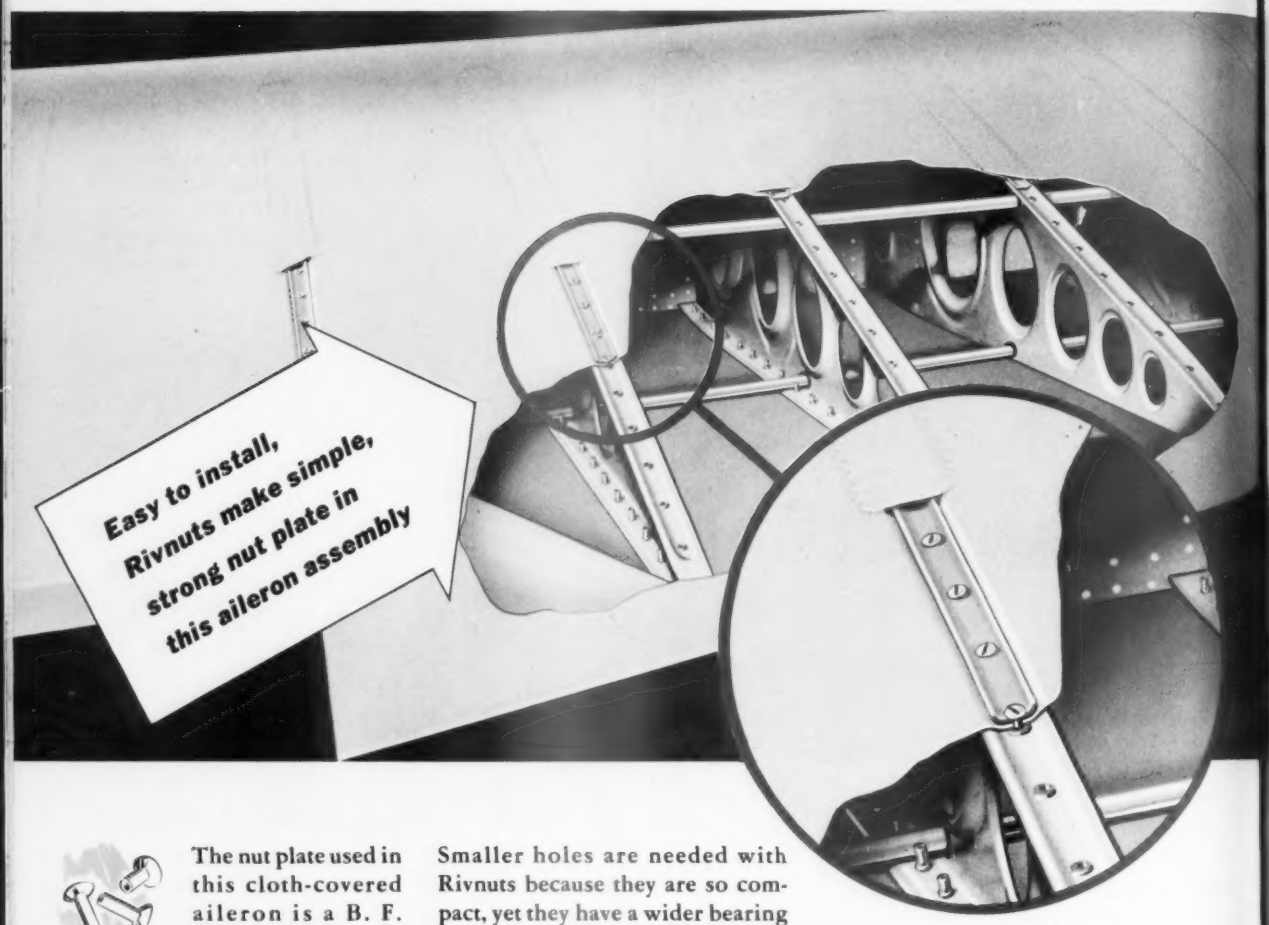

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the choice of the individual passenger would be dictated almost entirely by his desire with respect to the hour of departure, rather than by the effect of the indicated stops in lengthening the total elapsed time of one of the flights. Here, however, as in instances previously cited, we need not depend entirely on general statements of reasonable expectation, for a certain amount of specific information can be drawn from past traffic surveys. Table 5 gives the figures.

The strong preference of the through travelers for the nonstop service is evident from the difference between the two sets of figures in italic type in each column and also from the last line in each. Undoubtedly, the figures would have shown it as stronger still if the data available had made it possible to exclude those who used one of the schedules making intermediate stops because it gave them a through airplane to their ultimate destination beyond the limits of the sector directly considered in Table 5. Of the 13 schedules that ran from New York to Washington with one or more intermediate stops, for example, one was a transcontinental sleeper, one went through to Cincinnati and Chicago, three to Texas, one to Florida, and two to Atlanta. Less than half of the total number terminated at Washington.

As schedule frequency increases, the degree of preference for the express services will undoubtedly continue to increase; but, as the last line in Table 5 indicates, it is already common for each nonstop flight to attract from two to three times as many through passengers as make use of each of the flights that also serve intermediate points.

Nevertheless, even on the well-traveled routes included in the table the proportion of through traffic that moves by the local-stop schedules has an important share in the support of those schedules. The total volume of travel between terminals so far outweighs the volume to and from intermediate points that the great majority of through traffic can go to the nonstop schedules and there will still be enough left over to furnish a substantial backlog for the local-stop flights. In every one of the cases listed, more than 60 per cent of the travelers by local flights were proceeding straight through from terminal to terminal.

In the type of local service that is considered in this paper, however, it must be anticipated that the backlog of through traffic will shrink to well below the present normal. It is necessary to distinguish between the type of local-stop service now provided on the routes included in Table 5, with stops at a minimum interval of some 70 miles, and a service on which the interval was reduced to 20 or 30 miles and the number of stops correspondingly increased. The fact that a nonstop flight between New York and Washington has a block-to-block time of an hour and a half, whereas the corresponding time for a flight with stops at Philadelphia and Baltimore is two hours, obviously has not prevented a considerable number of through passengers from using the latter in particular cases; but, if half-a-dozen stops were to be made instead of two and if the total New York–Washington time further lengthened to some $2^1/_2$ hours or a little more as a result, the distinction between the patronage of the through and the local schedules would no doubt be more sharply drawn than it is now.

Another factor will operate in the same direction. If fully adequate local service were to be given to the entire area between Boston and New York, for example, many local schedules along a number of different routes would have to connect those points in order that the desired number of localities might be touched with a satisfactory frequency. The number of local-stop schedules would become so large that such through traffic as did not take the nonstop flights would be spread out thinly indeed among the flights that serve the intermediate stops.

Intermediate Stops

The application of these rather general statements to the determination of the amount of traffic that intermediate points would have to produce to support a local service may be illustrated by a particular example. All the schedules operated through Providence, R.I. during September, 1940, carried an average of 10.1 passengers on the Boston–Providence sector and 17.7 on the Providence–New York sector, notwithstanding the fact that each airplane departing from Providence carried, on the average, only 4.1 passengers originating at that point and that each one coming in had an average of only 4.7 passengers to be dropped there. If, instead of making an intermediate stop between Boston and New York at one large city, however, stops had been made at five or six much smaller points, those points would have had to produce a total of 8 or 10 passengers to justify the service (if DC-3's were still to be used) instead of 4.4 as in the case of Providence, since schedules as slow as those would have been would attract less through traffic as a backlog and would have to depend more largely on passengers originating or terminating at intermediate points.

Where traffic is heavy and surface transportation facilities are highly developed, the addition of intermediate stops not only effects a progressive concentration of air travel on the nonstop schedules but, if there is no nonstop schedule as an alternative, it may send potential air passengers back to surface transportation, as much of the advantage of the airplane over the fast train in total elapsed time between terminals will have been lost.

On the other hand, in the case of a 200- or 300-mile route operating a total of not more than four or five schedules a day, and not having to compete with the highest quality of high-speed rail service or with additional air routes connecting the same terminals by different sets of intermediate localities, intermediate stops could be added almost without limit without alienating through traffic, since the only available alternatives would be so much less speedy and satisfactory than even the most frequently interrupted and slowest of air-line operations. Under such conditions as that, if there is doubt of the ability of the terminals to develop enough through traffic to support the route, it may be expected to be advantageous to add considerable numbers of intermediate points, each of which will produce some traffic without alienating any.

A concrete example of the limited effect of stops on through traffic when schedules are few is furnished by the service between El Paso and Albuquerque, which in 1940 ran one round trip a day nonstop and one by way of three intermediate stops, with a resultant increase of just over 100 per cent in distance and over 150 per cent in total elapsed time when the intermediate stops were made. Notwithstanding the great differences, 35 per cent of the through passengers used the local flight.

The Extent of Air-Line Coverage, Actual and Potential

Consideration of the possible extent of the development of local air lines in the near future raises at once the question of the degree of completeness and adequacy with which the people of the United States are now served by air transportation. The question is by no means a new one. It has been the subject of a great deal of comment, some of it of an unfavorable nature. Data have been presented in a variety of statistical forms and by eminent students of the problems of air transportation. Analyses have been made of the proportion of the population of the United States who are "directly served by air transportation" and also of the proportion of income tax returns, of retail sales, and of various other economic indexes represented by the area of direct service.

In adding to the number of these analyses at the present time I am taking the opportunity to take exception to the implicit assumption that has been made in many cases—that the area served from an air transport point is to be determined by a municipal boundary. To adopt municipal boundaries has the virtue of simplicity, since it is in terms of local governmental units that census statistics are basically presented; but to derive aggregate figures and conclusions from the assumption that the Boston Airport does not serve Cambridge, that LaGuardia Field does not serve New Rochelle, that Burbank Air Terminal does not serve Pasadena, and that the Chicago Airport does not serve Evanston does violence to daily experience.

Area Boundaries

The ideal boundary of the area directly served in each case would no doubt be drawn to include all points from which the airport could be reached by ordinary driving or by public trans-

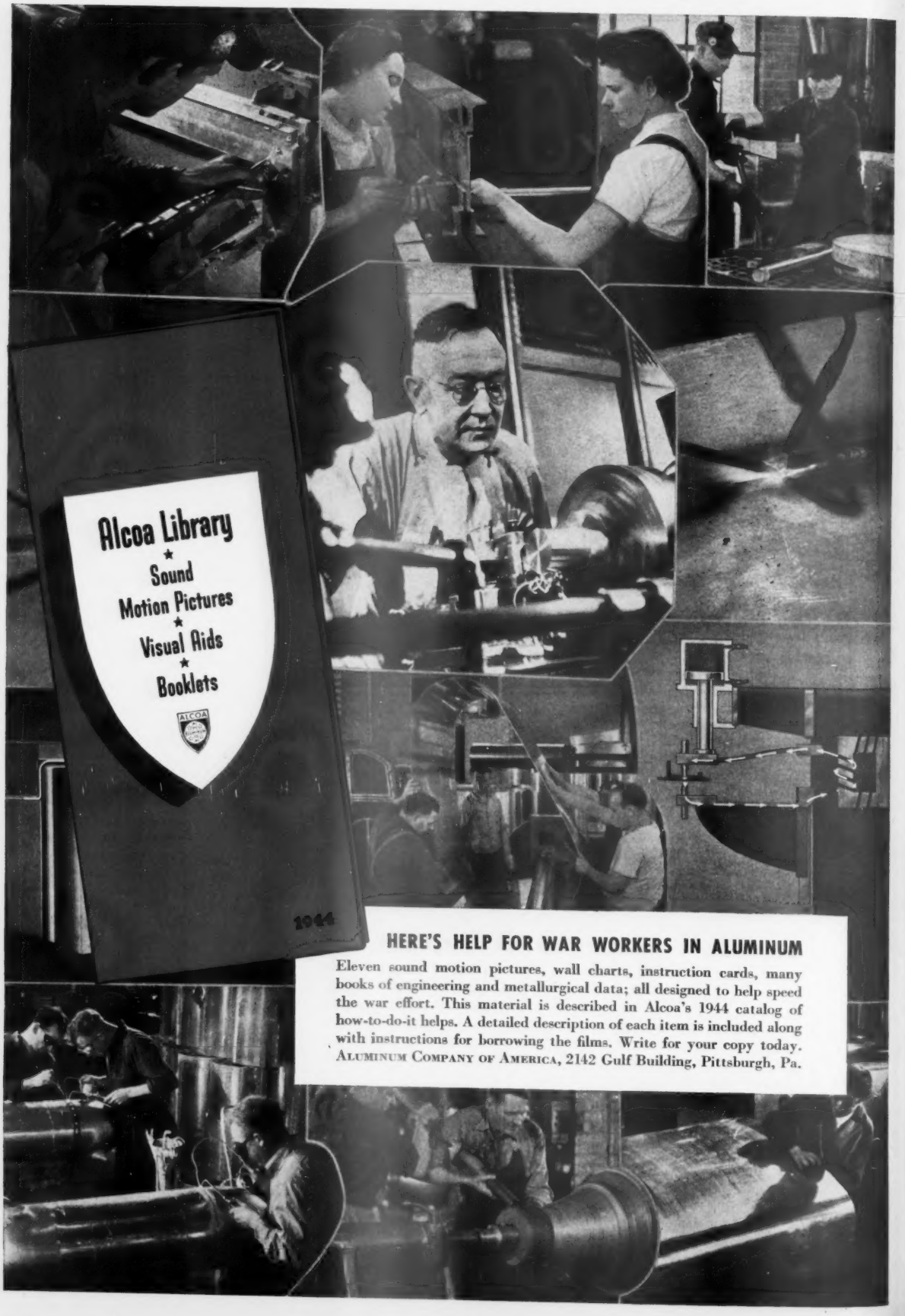
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TABLE 6

City	Municipal Population (1930)	Population Within a 25-Mile Radius (1930)	Population of Metropolitan Area as Defined by U.S. Census (1930)	Ratio of Population Within 25-Mile Radius to Municipal Population
New York	6,930,400	10,807,900	10,901,400	1.56
Chicago	3,376,400	4,384,000	4 364 800	1.30
Philadelphia	1,951,000	3,188,600	2,847,100	1.63
Boston	781,200	2,673,100	2,307,900	3.42
Los Angeles	1,238,000	2,348,600	2,318,500	1.90
Pittsburgh	669,800	2,140,400	1,953,700	3.20
Detroit	1,568,700	2,110,700	2,104,800	1.35
St. Louis	822,000	1,340,100	1,293,500	1.63
Cleveland	900,400	1,307,300	1,195,000	1.45
Rocky Mount, N.C.	21,400	172,000		8.04
Parkersburg, W.Va.	29,600	166,000		5.60
Greenville, S.C.	29,200	160,500		5.50
Spartanburg, S.C.	28,700	159,300		5.55
Monroe, La.	26,000	103,600		3.95
Green Bay, Wis.	37,400	140,000		3.75
Bloomington, Ill.	30,900	108,000		3.50
Williamsport, Pa.	45,700	149,000		3.29

port within a stated length of time—say, 45 min. Obviously, the construction of a boundary on that basis would call for an enormous amount of local knowledge and map study, however, and the most reasonable approximation is to be secured by including the area within a fixed radius. The Civil Aeronautics Board has made extensive use of a 25-mile radius for the purpose, and I have used that figure in preparing the present paper. It is adopted as typically representing about the equivalent of 1 hour's travel time by highway. Obviously, there are some cases, as in proceeding due west from LaGuardia Field, in which it would take substantially more than an hour to cover an air-line distance of 25 miles; but there are other cases in which the converse is true. I believe that on the average the equivalence is reasonably good. I do not, of course, suggest that to have air transport facilities within 1 hour's time by surface travel is the best that can be hoped for. The shorter the time can be made for every community and every individual in it the better, and I shall have some specific suggestions on the possibility of attaining substantially higher standards; but a 25-mile radius gives a starting point, and few of those who wish to use air transportation for anything more than a short trip are likely to be dissuaded by the necessity of driving for anything up to an hour to reach the airport of departure.

The best evidence that points of air transport service now actually draw large amounts of traffic from much more than 25 miles away is furnished by the fact that where two points having service are within 40 or 50 miles of one another (or even as much as 100 miles, in cases where highway conditions for fast driving are good) and where one of the two points has a much more frequent air service than the other, the ratio of the amount of travel originating at the less favored of the two points to its immediate population is usually well below the national normal. The obvious explanation is that many of the people who live in that area are traveling on the surface to the larger neighboring city to start their trips by air, in preference to awaiting a schedule at the local airport and then perhaps making a connection.

Extending Area of Direct Service

To illustrate the effect of escaping the limitations of municipal area, replacing it by a reasonably extended area of direct service, the figures for the largest cities and for some particularly striking cases among the smaller ones have been tabulated in Table 6. In this table, as in preparing all of the subsequent charts and statistics that involve area population figures, the figures used are those of the 1930 census, as a substantial amount of work on the subject had been done before the 1940 census was available and it was desired to avoid complete repetition.

Upon the 25-mile basis, Fig. 1 shows in solid black the areas now served. The cross-hatched areas surround potential additions on a basis subsequently to be discussed. The spots look small and widely scattered in some parts of the country, yet they cover the dwelling places of 64 per cent of the American people.

TABLE 7

Range of Populations Within a 25-Mile Radius	Number of Points Certificated	Cumulative Number of Such Points
Over 1,000,000	14	14
500,000–1,000,000	17	31
200,000–500,000	50	81
100,000–200,000	61	142
50,000–100,000	63	205
20,000–50,000	45	250
10,000–20,000	18	268
Under 10,000	13	281*

* St. Petersburg, Long Beach, and Oakland are included in the population figures of Tampa, Los Angeles, and San Francisco, respectively.

The total number of points at present certificated for air transport service in the United States (excluding points certificated for pickup service only) is 284. Their area populations lie in the groups shown in Table 7.

In Fig. 2 are plotted the cumulative percentages of national population against the cumulative number of cities served, starting with the points of largest area population and working down. The solid line, covering all points now certificated for service, runs as previously mentioned up to 64 per cent of the total population, and it shows among other things that the 20 largest points now covered by air transportation serve 34 per cent of the population of the United States, while the 75 largest serve more than 50 per cent. The dotted line that carries on from the end of the solid portion represents the increase in population coverage that would result from progressively increasing the number of points served, starting the addition with the point now unserved,† which contains within a 25-mile radius the largest population, excluding from the computation (where the circles overlap) any part of the area that has already been counted as within 25 miles of any currently certificated point, and then proceeding to pick up additional points in order of decreasing area population.

† Worcester, Mass., with an additional area population of 456,000.

TABLE 8

Population Range Within a 25-Mile Radius)	Number of Points Now Certificated	Cumulative	Number of Possible Additional Points	Cumulative	Percentage of Points in Population Bracket Already Certificated
Over 1,000,000	14	14	0	0	100
500,000–1,000,000	17	31	0	0	100
200,000–500,000	50	81	9	9	85
100,000–200,000	61	142	55	64	53
50,000–100,000	63	205	52*	116	55 (30)*

* Only points including at least one city or town of 15,000 population or more were included in this analysis. If areas drawn around smaller communities or in purely rural areas of exceptionally high population densities were included, it is roughly estimated that this figure would be increased to about 150. The figure in parentheses in the last column is based on this estimate.

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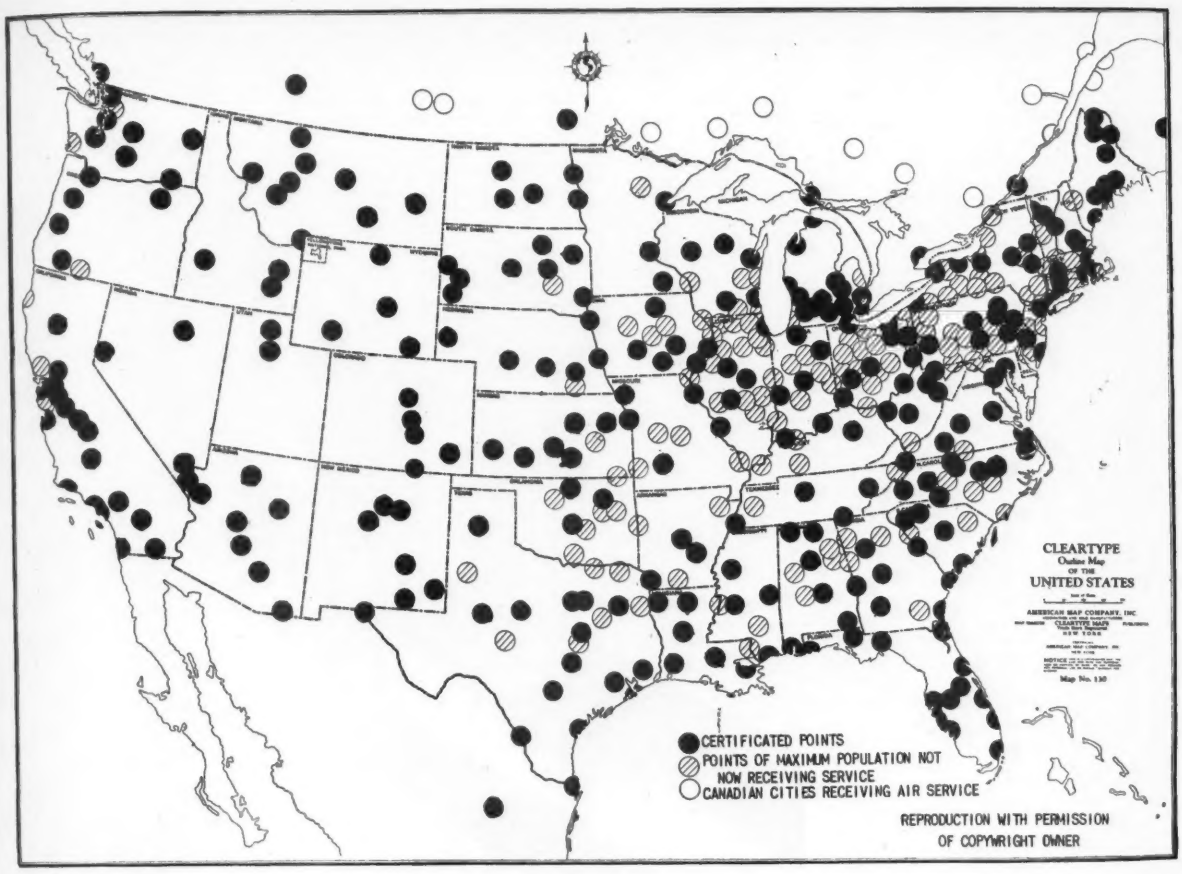

FIG. 1.

A comparison of the number of potential new points with the number now served within corresponding population ranges is shown in Table 8.

The addition of 116 points to the number now served, bringing the total up to 400, could increase the proportion of the population domiciled within a 25-mile radius of a point of service to 76 per cent. Further increases in total number of points would have the following effects:

Number of Points	Per Cent of Total Population Located Within a 25-Mile Radius of a Service Point
284*	64
400	76
600	82
1,000	88
1,500	94
2,000	98.5
2,400	100

* Number now certificated. In round numbers the present number of certificated points would have to be doubled in order to serve 80 per cent of the total population, doubled again to bring the proportion served to 90 per cent, and doubled a third time to bring it to 100.

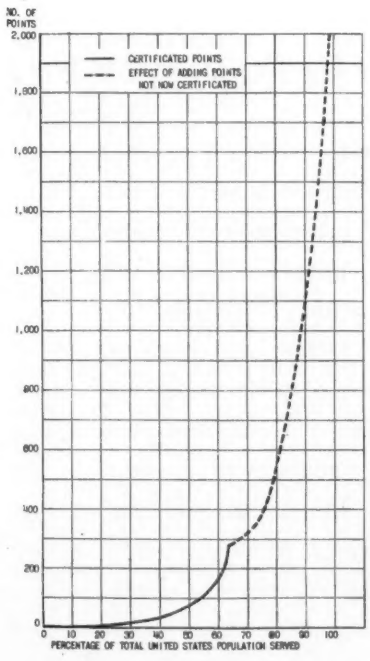

FIG. 2.

In estimating the amount of local service that could be self-supporting or that could be supported without unreasonable burden on the Federal Treasury, and the actual completeness and degree of closeness of coverage of the area and population of the United States that is practicable, a variety of bases is available. The most straightforward, although obviously not sufficient in itself for predicting the future, is the direct record of past experience with routes essentially of the local-service type.

Representative examples are shown in Table 9.

None of these routes was producing enough nonmail revenue immediately before the war to cover half of its operating expenses. The public desire for local service to the smaller cities had not, at that time, developed to the point of permitting even a reasonable approach to self-support except in cases where a large amount of through traffic could be handled between main terminals or beyond. The service to the intermediate points was almost incidental.

Large increases in feeder service before the war would have been practicable only through mail payments averaging at least 35 cents a mile—the equivalent of approximately $500 per year for every mile of route served with two round-trip schedules a day or from $70,000 to $100,000 per year for every ten-passenger airplane kept in active use. The market was not ready to

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TABLE 9

Route	Number of Round-Trip Schedules per Day in September, 1940*	Average Pay Passenger Load for Fiscal Year, 1941	Nonmail Revenue per Revenue Mile (Cents)
Norfolk–Knoxville	2—1†	2.76‡	13.78
Detroit–Sault Ste. Marie	1	4.35	22.30
Jacksonville–Miami (via Tampa)	3—2*	4.20	20.61
Boston–Caribou	6—1*	4.51	28.24
Boston–Montreal	2		
Salt Lake City–Great Falls	2	4.23	19.96

* The number of schedules is given for April, 1941.

† Where two figures are given they are for the maximum and minimum numbers on various parts of the route.

‡ Covers only the last 6 months of the first fiscal year, which were the first 6 months of operation of the route.

absorb the product, except through governmental forcing.

The postwar period will obviously see a great change in that respect. It is risky business to estimate how great. Obviously, the ratio of increase will vary with the local conditions and, obviously, it will vary most of all with the level at which future rates of fare may be established. In general, I believe that the ratio of postwar to prewar traffic, on routes which were in full operation before 1942, will be largest in those cases in which the competition of surface transportation was keenest. Where there is no good transportation except that afforded by air, there has been a more rapid approach to full development of the potential traffic than in those instances where surface transportation is excellent and its accustomed patrons are correspondingly slow to consider the possibility of shifting their patronage to an air line.

Other things being equal (i.e., distribution of population and economic activity, number of daily schedules offered by the various forms of transportation, proximity of airports to business centers, etc.), and on the assumption of an average rate of fare of 4 cents per mile as against the present figure of slightly over 5, I offer a personal speculation that the ratio of increase from 1941 to a time 2 years after the war will range from 2.5, where the dependence on air transportation is most complete, to 4.0 where surface transport offers its strongest competition. If the rate of fare can be brought down to 3 cents a mile, I would expect at least a further 50 per cent of increase. The local routes just tabulated, which were averaging four passengers per schedule before the war, might then be expected to average ten or fifteen in the postwar period and to present a different picture economically and an extremely satisfactory one.

The trend of experience on these routes in the years immediately before the war supports that encouraging view of the future. For the routes that had been in continuous operation for several years, the statistical record of the trend is shown in Table 10.

Such figures justify an expectation that soon after the war such routes as those cited will support the use of aircraft of 15-passenger capacity or more and three or four schedules a day in place of the one or two that were the general rule in 1941. Lest we grow too sanguine of the immediate postwar future, however, it must be remembered that the routes that have been cited are scarcely typical of the great majority of those that would be created in a nationwide provision of local service on a really grand scale. Of the 34 points that were actually being served by the six routes in the spring of 1941, excluding major terminals from consideration, ten served populations (within a 25-mile radius) of over 100,000, and 21 in the aggregate similarly served populations of 50,000 or more. Since there are (as indicated in an earlier tabulation) only 64 possible points that would serve over 100,000 population each which do not now have air transportation, it is obvious that any substantial increase in the total number of points now certificated for service is going to involve the creation of many routes dependent on communities much smaller, as a whole, than those that lie along the existing routes on which I have reported the existing experience.

Diffusion of Through Traffic

It would also be necessary to allow for the unfavorable effect of diffusion of through traffic as additional routes picking up different sets of intermediate points were added between the same terminals. A substantial part of the passenger load carried on the Norfolk-Knoxville route, for example, was composed of passengers traveling straight through from Norfolk to Knoxville or between points lying beyond those terminals. The addition of another Norfolk–Knoxville route, swung to one side of the existing one to serve different cities along the way, would tap new populations at the intermediate points but would in itself add nothing to the through traffic, which would then divide between the two (or more) routes in some proportion depending on their relative degrees of circuity and other advantages.

If local routes as far above the probable average as most of those that have been tabulated may be expected to produce postwar average loads of from ten to fifteen passengers on each flight, there must be many possibilities for the future which would serve populations so much smaller than do the routes now existing, or would otherwise be so much less promising, that their corresponding average passenger loads would be more likely to lie in the range from four or five to eight or ten. The practicability of operating such routes without substantial financial support from the Government will, in general, be dependent upon the development of aircraft and operating practices that will make it possible to get the total cost for operating an eight-passenger airplane (including all overhead) down to less than 30 cents per mile, with roughly proportional figures for machines of somewhat smaller or larger size. There will, of course, be cases in which the desirability of air service over short distances will be so great as to make it possible to establish the rates per mile at well above the level required for through service and still realize a large part of the total potential traffic, but such cases are likely to exist only where surface travel conditions are exceptionally bad.

I shall have more to say of the inherent economic handicaps of the small airplane in transport service in a subsequent section of my paper, but I may say at once that they are serious and that the problem of operating such aircraft economically enough to keep the commercial rates within the range acceptable to those served may be an insoluble one. But its insolubility certainly should not be assumed or accepted without a prolonged struggle to find means of overcoming it.

TABLE 10

Route	Average Pay Passenger —Loads for Fiscal Years— 1939	1940	1941	Average Percentage of Annual Increase from 1939 to 1941	Percentage of Increase for 5 Years if Continued at the Same Rate
Detroit–Sault Ste. Marie	2.71	3.56	4.35	26.5	223
Jacksonville–Miami (via Tampa)	2.28	3.35	4.20	35.6	359
Boston–Caribou and Boston–Montreal	3.67	4.26	4.51	10.9	68
Salt Lake City–Great Falls	2.71	3.39	4.23	24.9	204

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A Hypothetic Project of an Air Transport System

The determination of the rate at which local services will actually be developed ultimately depends on the separate evaluation of an enormous number of individual possibilities, but an overall approximation can be made in terms of certain assumed standards, the meaning of which in terms of convenience to the traveling public each of us can then picture to himself.

Before proceeding with that project, I must emphasize its tentative and speculative nature. I am not committed to any conviction that the system of air transport routes I shall describe could or should be put into effect, even in the most general way, as of any particular date, or indeed that it will take effect at all. It seems to me exceedingly useful, however, to make a simple set of basic assumptions and see to what conclusions they would lead.

I have adopted, for purposes of computation and d scussion, a set of standards which assume that in areas of dense population, such as southern New England and the central portion of the eastern middle states, the points served by air transportation should be spaced no more than 10 or 12 miles apart; while in regions of low population density, with most of the towns having concentrated populations of 1,000 or less, the corresponding spacing of points might reasonably be from 50 to 60 miles. Specifically, I have considered the air transportation that would result from the establishment of points of service in general conformity with Table 11.

Table 11

Average Population Density per Square Mile	Average Area (Square Miles) Assumed to Be Served by Each Air Transport Point	Average Straightline Distance Having to Be Traveled to Reach a Point of Air Transport Service (Miles) *	Average Population Served by Each Point
500 or more	100	3	60,000
300–500	120	4	50,000
225–300	160	4	42,000
180–225	200	5	40,000
150–180	250	5	40,000
120–150	300	6	40,000
100–120	350	6	38,000
80–100	400	7	36,000
70–80	450	7	34,000
60–70	500	7	32,000
50–60	550	8	30,000
40–50	650	9	29,000
30–40	800	9	28,000
20–30	1,000	10	25,000
15–20	1,200	12	22,000
10–15	1,500	13	19,000
3–10	2,000	15	14,000
1–3	3,000	18	7,000

* The maximum distance having to be traveled from any point within the area served, assuming a uniform distribution of points within the area of substantial uniform population density, would be about 75 per cent more than the average distances as here tabulated.

Obviously, an attempt to apply any such rule with rigorous uniformity in individual cases would lead to some absurd results. For example, there are many cases in which it would be physically impossible to find an airport site within the area called for by the tabulated specification. Obviously, some sections of the country make much more use of air transportation in proportion to their population than others. Considered merely as a specification of an average, however, it provides a useful basis for further study. I hope that it will be accepted as a basis that does not obviously err either on the side of overgenerosity, if it be considered not as an immediate proposal but as possibly looking well into the future, or on the side of excess of conservatism.

Analysis of the distribution of population in the continental United States shows that approximately 3,400 air transport stops would be required to fit the suggested standard. This is, of course, a substantially larger number than the 2,400 previously mentioned as sufficient to reach the entire population of the United States, but it will be recalled that the earlier figure was based on the assumption that every point could serve the entire area within a 25-mile radius, whereas it is now being assumed that in the densely populated areas the radius of service will be expected to be much less than that. A system of 3,400 stops arranged in accordance with the present assumptions would actually bring air transport service to within a 25-mile air-line distance of the places of residence of approximately 99 per cent of the population of the United States and to within 10 miles of approximately 75 per cent.

In translating a hypothetic number of points and their spacing into the route mileage required to connect them, I have assumed that 50 per cent of all points served would lie at the intersection or junction-point of two routes. For purposes of comparison, I note that approximately 25 per cent of the points now certificated for air transport service are at such an intersection or junction of presently certificated routes.

To meet all those assumptions would require about 200,000 miles of route or an addition of about 160,000 route miles to the existing system.

Servicing Sparsely Settled Areas

In the most sparsely settled parts of the country, a single round trip daily over many of the routes in such a system might meet all reasonable requirements. Where points are closely spaced and large cities are near at hand, the number of daily schedules would need to be at least four or five, either to appear as rendering anything like adequate public service or to compete with any success with transportation by rail and highway. I believe it a reasonable assumption, to add to the assumptions that have already been made and which each reader of this paper can modify upward or downward to suit his own views, that if a system of the type described here were to be established the average number of daily round trip schedules on the route mileage newly created with the primary purpose of rendering local service would be at least 3.0. If it were impossible to support that large a number of daily schedules on the average, there probably would not be justification for so large a number of routes or stops as has been suggested.

Taking all these figures together, it appears that the hypothetic system of local routes would require operation of about 350,000,000 aircraft miles per year in addition to the mileage flown on the routes that already exist and such others as may be established in future for the primary purpose of supplying better connections between major centers rather than of serving additional intermediate points. If the prewar mileage of operation on existing routes is multiplied by three within a short time after the end of the war, which seems to me a reasonable hope (even when allowance is made for the probable increase in average size of the aircraft used on such routes), and if the effect of new through connections between major points is taken into account, such as the newly established through services between Washington and principal midwestern and western cities, the mileage flown annually on those routes would be about 400,000,000, bringing the possible national total for routes of all classes to 750,000,000.

Local Route Mileage

The annual mileage per airplane on local routes will certainly be substantially less than on the through services for a variety of reasons, including the occasional necessity of concentrating most of the day's schedules over short routes into a small part of the day to fit the demands of a commuting or shopping public. I suspect that 400 miles per day, or about 150,000 miles per year, may be as much as can be drawn from the average aircraft used in service of the type here under discussion. On that assumption an opera-

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tion of 350,000,000 miles per year would require a total fleet of a little more than 2,000 aircraft.

In turning away from this structure of hypothesis and computation, it is interesting to compare some of its features with the corresponding features of other forms of transportation. Only round numbers are given, based in the cases of railroads and bus lines on averages over several years (see Table 12).

The total mileage of surfaced roads in the United States, excluding city streets, is approximately 1,350,000, or about six times the route mileage of the hypothetic system of air routes.

It is noteworthy that the route mileage figure for the imaginary air-line system should be so nearly equal to the total railway mileage of the United States. The similarity is, of course, purely coincidental, since the distribution of railway mileage played no part in the derivation of the air-line figure. It is also notable that the assumptions I have adopted would call for an annual aircraft mileage in regular transport which would exceed the total passenger-train mileage by about 80 per cent and would fall only 40 per cent short of the total for intercity motor buses. The number of points served by the steam railroads would, on the other hand, be enormously larger. Railroads frequently make stops at intervals of 2 miles or less, and railroad systems were for the most part constructed when passengers had still to reach the railroad stations on foot or by horse-drawn vehicle. Air-line stops, even for the most local service, will be planned with the availability of the private automobile as a feeder in mind.

If such a system had actually been created before the war, I do not believe the local routes would have shown an average passenger load of more than two or three passengers. The average mail pay necessary to keep the services going at the costs then prevalent would probably have been at least 40 cents a mile, calling for an aggregate annual air mail expenditure of approximately $150,000,000, in addition to the $21,400,000 of mail compensation that was paid in the calendar year 1941 on the existing routes.*

I have every hope that within a reasonably short time after the end of the war the public acceptance of air transportation will have so increased as to enable this hypothetic system of local routes, if it were to be established and to be operated at such rates of fare per mile as now prevail, to develop an average load of six passengers or more and to reduce by a half the amount of mail pay that would be required to support it as compared with what the prewar need would have been for the same system. The rapidity with which further increases in air travel might further reduce the extent to which such a system of routes would have to depend upon Government aid or the rapidity of progress toward the possibility of its complete self-support are matters upon which I will venture no prediction. As previously noted, they will depend in large part on the future success of air-line operators in getting unit costs down for a type of service adopted to handling passengers in small groups.

I am taking no position in this paper regarding the national policy with respect to the rate at which local routes should be developed or to the desirability of creating a really complete coverage of the United States by local services within 2, 5, or 10 years or any other length of time, but I find it beguiling to contemplate the form that such a complete coverage would take, the quality of public service that it would render, the volume of operation that it would entail, and the amount of equipment that it would require.

* The contribution that the additional local services, acting as "feeders," would have made to passenger load on the existing routes would have reduced the amount of mail compensation required by the existing services; but that factor would hardly have made a difference of more than $3,000,000 or $4,000,000, as against the increase of about 40 times that amount that would have been required for the direct support of the local services.

TABLE 12

	Hypothetic Air Transport System (Including Both Through and Local Routes)	Steam Railroads (Prewar)	Intercity Bus Routes (Prewar)
Number of points served	3,400	60,000	...
Route mileage	200,000	250,000	350,000
Vehicle miles operated per year	750,000,000	400,000,000*	1,250,000,000

* Passenger-train-miles.

Part II

Operating and Equipment Problems

Local air transport operations have many equipment problems in common with other types of service, but they add two of their own: (1) loss of time and increase of cost due to frequent stops and (2) tendency of unit operating costs to rise with decreasing size of aircraft.

Time spent on the ground or unnecessarily spent in approaching, taxiing, and taking off and climbing is expensive both in direct increase of operating cost and in passenger dissatisfaction. It decreases the service that can be secured from each airplane, increases engine time and fuel consumption, and increases the working time of flight crews and the flight crew expense per unit of operation. In round numbers, the direct flying and equipment depreciation costs for each minute sitting on the ground with the engines stopped amount to as much as the total of all costs for a quarter of a mile of flying. For run-up time and taxiing time the cost is substantially higher.

Maintenance

Engine and air-frame maintenance, especially on landing gears, are increased by every landing and take-off, without regard to the length of time spent on the ground. Taking all these effects together, increases in direct operating expense, maintenance, and depreciation alone, under present operating conditions, probably cause an increase in total operating expense of from 10 to 20 per cent when stops are spaced 30 miles apart instead of 300. The additional expense of keeping the necessary ground personnel at so many intermediate points causes a substantial further increase in total cost amounting to another 15 per cent or more for the assumed case of 30-mile flight stages. In this connection, as in all other uses of the term herein, "total cost" includes all indirect and overhead items.

Effect of Spacing of Stops on Total Operating Cost

In Fig. 3 I have plotted what I believe to be a fair indication of the effect of spacing of stops on total operating cost, other things being equal. The curve assumes present practice with respect to time consumed by each stop and assumes also that the air line will depend on its own full-time personnel at each station. There are obvious possibilities of future economies which will flatten the curve. Aside from the hope of reducing time spent on the ground and taxiing distance, to be discussed in more detail in a subsequent paragraph, local lines running only two or three daily schedules in each direction through a particular station may be able to use personnel who combine their work for the air line, requiring them to be on duty only intermittently, with some other connection with the airport that will occupy a large part of their time and reduce the cost of their services to the air carrier.

The necessity of studying every possible means of reducing the slope of the curve of cost against distance is obvious. As it stands, it would require that rates of fare per mile for the typical local service be from 15 to 40 per cent higher than for through services. When that increase is added to the increase that may result from the necessary use of relatively small aircraft to handle the relatively light loads typical of many of the local routes, the competitive situation as against surface transportation would become difficult.

Effect of Stops on Average Speed

The effect of loss of time on the ground upon the average speed of trans-

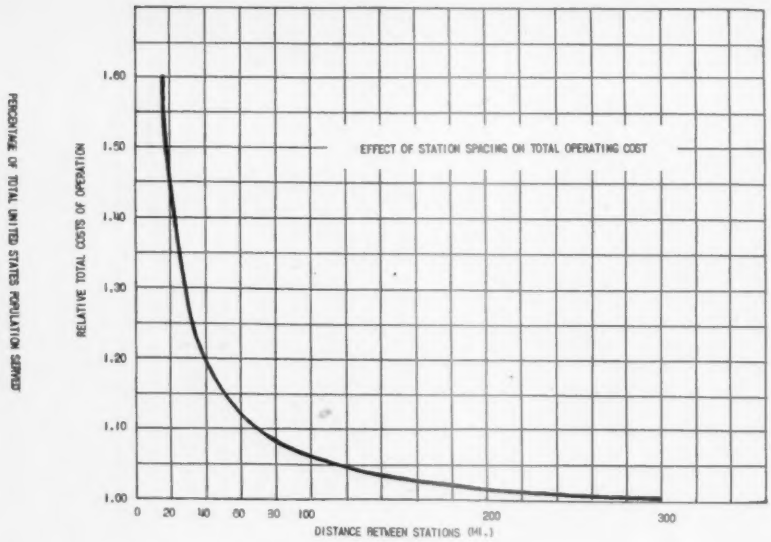

FIG. 3.

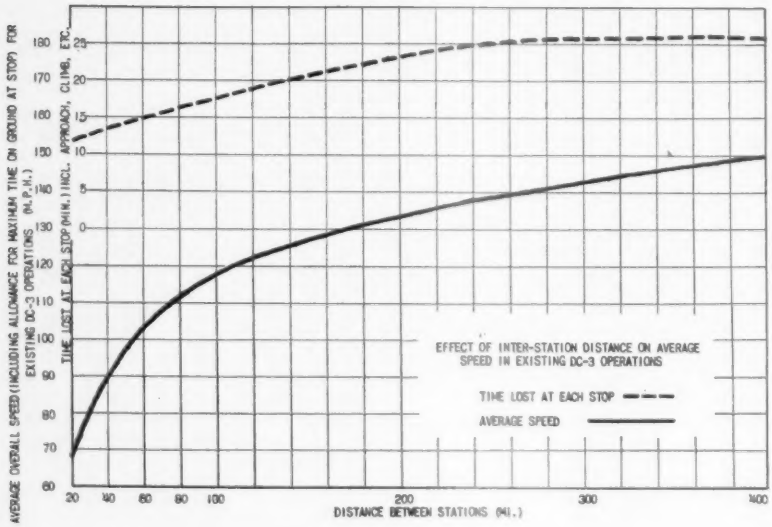

FIG. 4.

portation, and thus upon the value of the service rendered to the patrons, is obvious. With stops at 30-mile intervals, a saving of 1 min. at each stop is equivalent to an increase of about 20 miles an hour in cruising speed.

To draw on actual experience, the average speed from take-off to take-off has been plotted against distance in Fig. 4 for a number of current DC-3 operations. It should be emphasized that the time here is taken from take-off to take-off rather than from take-off to landing, the standing-time at one stop being included in the total elapsed time for each flight. Standing time, however, has been assumed never to exceed 5 min., thus eliminating the effects of waiting for connections or for the reworking of mail and express in particular cases. The average as thus computed seems to give the fairest measure of the overall speed at which the passengers are actually being moved.

Fig. 4 also carries a curve of the time lost by each stop, gauged by comparing the total elapsed time (again including the time spent on the ground) with the time required to cover the same distance in steady cruising at 180 m.p.h. To get the probable schedule time for a distance of 60 miles, for example, divide the distance by three and add the 15 min. read from the curve, making an anticipated total of 35 min. and an average overall speed of 102 m.p.h. The curve based on existing scheduling practice is fairly approximated by a linear variation from 12 min. lost in a 20-mile flight to 25 min. in one of 225 miles and a constant 25-min. value for any greater distance.

The corresponding variation of speed shows an overall speed, including allowance for time spent on the ground at intermediate points, of only 65 m.p.h. where the stations are spaced but 20 miles apart, increasing to 90 m.p.h. for a 40-mile spacing and 118 m.p.h. for 100-mile intervals.

Reducing the Time Loss at Stops

The shortening of the time lost at each stop is certainly a prime condition of the successful development of local service. To take the most obvious element first, the time at rest at the loading platform must be materially cut. Local trains stand for not over a minute at each stop, during which time they may take on and discharge a dozen or more passengers through a single car door. Bus stops are materially shorter than those of the railway. The typical local air line will not handle more than three or four passengers during a stop at a typical intermediate point, and the goal certainly ought to be to reduce the total time at rest to not over 30 sec., in place of the present 3 to 6 min. The future development of this type of service may permit passengers to keep with them all of their personal baggage (which would generally be light in any case for a local operation) and thus save the time now spent in delving into baggage compartments. Mail and express compartments may be so designed, and the sacks so loaded originally, that those destined for a particular point can be reached and withdrawn as quickly as the compartment door can be opened and closed again. The checking of passengers individually by name may be replaced by the simple presentation of a ticket stamped with the date and flight number. Possibilities of saving a few seconds here and a few there are obvious, but their realization will require that economy of standing time be held in mind as an important objective in the design of the equipment and in the whole planning of the operation.

Traffic Delays

Traffic delays should be negligible except at terminals if suitable means are developed for insuring air transport movements priority over nontransport operation. If the arriving transport plane at a small community that can support only one airport has to find its way through a bevy of training machines or to take its turn without preference over other traffic, a great deal of time can be lost. If, on the other hand, the locally prevailing air traffic rules insure that each of the relatively small number of transport planes that will operate at such a point during the day will be given a clear path as soon as its approach is known, delay should be brief, for only rarely are intermediate points on local routes likely to have two or more transport airplanes arriving or departing nearly enough at the same time to interfere with one another.

Airport Modifications

A saving of taxiing time can be made, although at the expense of increased brake maintenance, by the use of tri-

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Helping the mighty Martin "Mars" smash world's records on its recent long distance flights were the two Lawrance Aerolectric Power Plants with which this famous airplane is equipped. These specially designed units, like all other Lawrance models, make possible the wider use of electricity in aircraft by providing a dependable flow of current to operate such vital accessories as cargo hoists, main engine starters, radio, lights, and cabin heating and ventilating equipment.

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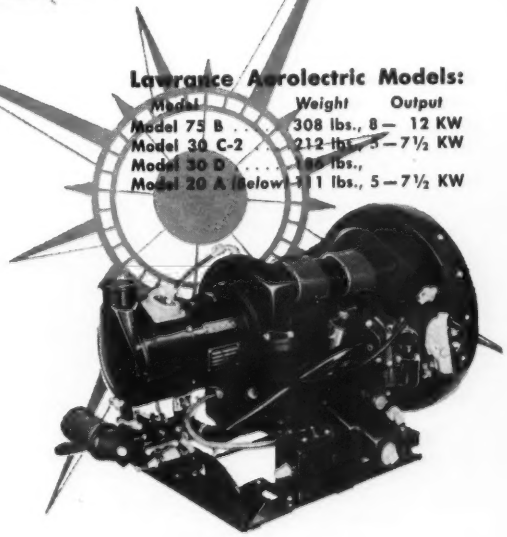
Lawrance Aerolectric Models:

Model	Weight	Output
Model 75 B	308 lbs.,	8 — 12 KW
Model 30 C-2	212 lbs.,	5 — 7½ KW
Model 30 D	95 lbs.,	
Model 20 A (below)	111 lbs.,	5 — 7½ KW



LAWRANCE AERONAUTICAL CORPORATION

LINDEN, NEW JERSEY

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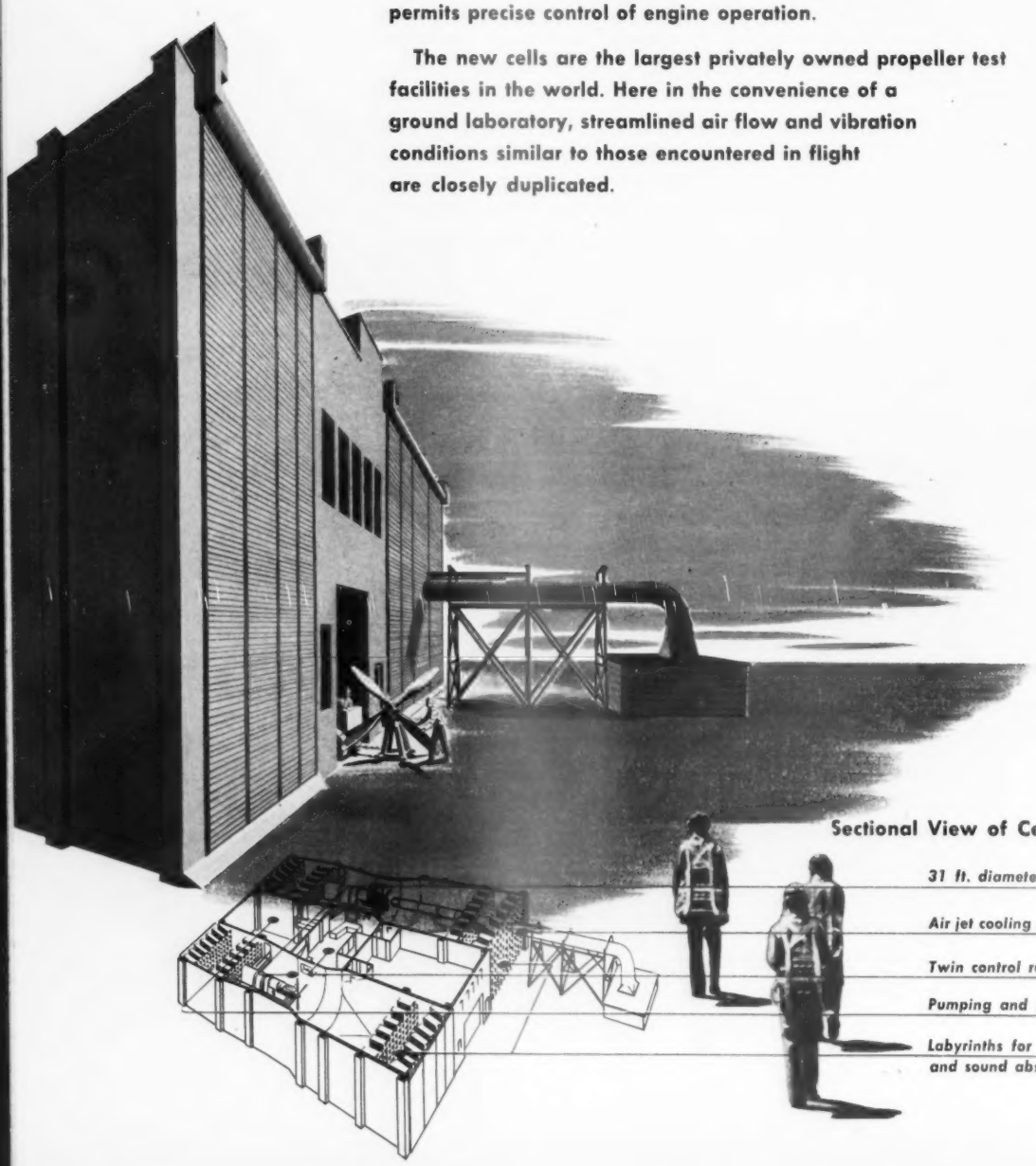
Stepping far ahead of current engine and aircraft design, the new Curtiss twin test cells have been built for the express purpose of developing the huge blades of the future. Propellers up to 30 ft. in diameter may be tested on either liquid or air-cooled engines with ratings up to 5000 HP. A scientifically designed venturi section eliminates turbulence of air. A combination of cooling systems permits precise control of engine operation.

The new cells are the largest privately owned propeller test facilities in the world. Here in the convenience of a ground laboratory, streamlined air flow and vibration conditions similar to those encountered in flight are closely duplicated.



Sectional View of Cells

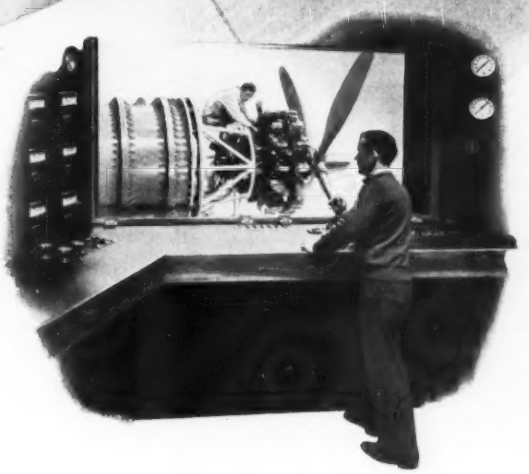
31 ft. diameter venturi sections.

Air jet cooling tube.

Twin control room.

Pumping and refrigerating units.

Labyrinths for air flow straightening and sound absorption.



In operation, the 48-inch air jet cooling tube slides forward until it covers the spinner and is within a few inches of the propeller blades. A central cone inside the tube spreads the air into annular ring form to deliver it around the hub and directly into the cowl opening. The operator in the sound-proof control room has a clear view of the propeller and engine during the test from several observation windows.

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cycle landing gears and taxiing at materially higher speed than is now common. That again requires anticipation by the aircraft designer and especially calls for absolute brake reliability. The brightest prospect of all for saving both time and money in taxiing lies in the general adoption by communities of the suggestion recently presented by Dr. W. Bailey Oswald—that the airports used as intermediate points on local routes should have a double-length runway with the terminal at the midpoint, landing being made from one end of the runway to the middle, take-off from the middle to the opposite end, and taxiing virtually eliminated.

The runway length for such a field would typically have to be about 6,000 ft., and it would be difficult to provide more than two runways, and certainly impossible to provide more than three, without so narrowing the angle in which the terminal building would stand as to create a hazard. The land area needed for such a layout would be much greater than most small or medium-sized communities have considered in planning their airports, but the arrangement certainly ought to be kept in the public eye as a desirable one where it is practicable to secure it.

An extreme form of the same proposal would reduce the airport to a single runway with the terminal midway of its length, in the anticipation that transport aircraft of the future, with tricycle gears, will be able to land and take off in cross winds so strong as to make it possible to use the same runway for all wind directions. If operation could in fact be safely and regularly maintained from such a landing strip, the land requirement would create no serious problem and the placing of the terminal at the midpoint of a strip long enough to accommodate landings on one end and take-offs on the other would be greatly facilitated.

Aircraft Modifications

The introduction of the tricycle gear certainly constitutes a great step toward independence of cross winds. I believe, however, that operators who have had large experience with the most modern aircraft will seriously question our readiness to ignore cross winds entirely in a regular transport operation. The practicability of doing so ought to be earnestly discussed by engineers, operators, and experienced pilots before any conclusion is reached. Any such operation would certainly present the designer with another problem in the development of equipment to meet a special condition not heretofore likely to be encountered. Among other things, the lateral strength of the landing gear might need to be increased to above present regulatory requirements. The use of castoring wheels, which will track with the true direction of the movement of the aircraft relative to the ground as it touches, is a more radical possibility. Perhaps the single strip may at least prove usable, with great resultant economy, in construction of local airports where the winters are mild or where strong wind components at right angles with the prevailing wind direction are only infrequently encountered. Certainly something radically new, either in equipment characteristics or in operating technique, will be needed before a landing in a strong cross wind on an ice-covered runway can be regarded with any complacency.

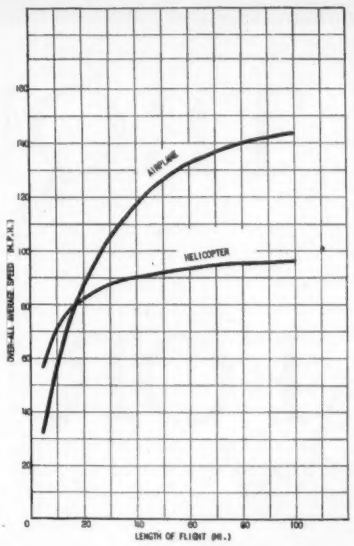

FIG. 5.

As Fig. 4 has indicated, the present rule is for each stop in a short-range operation to add about 13 min. to the total elapsed time as compared with the time required to cover the same distance at the cruising speed of the aircraft at its normal operating altitude. That loss of time must be reduced if local service is to develop to the extent that we may hope for. The limit of present reasonable hope seems to me to be that the loss might be cut from 13 min. to 7 where the amount of taxiing now normal is required or to 5 min. where the runways are long enough for a substantial elimination of taxiing. The taxiing that would ordinarily be necessary in covering the distance from the runway to a loading point adjacent to the terminal building, which must be well displaced from the line of the runway in the interest of safety, may be eliminated by placing the building amply far back but by loading and unloading the aircraft immediately adjacent to the runway and using motor-vehicle transportation for the passengers between the loading point, which need present no permanent obstruction above the ground, and the terminal.

Benefits of Timesaving

After all that has already been said, it is scarcely necessary to dwell on the benefits of the saving of 5 to 8 min. in the time lost on each stage of a local operation. On 30-mile stages, for example, an airplane with a cruising speed of 180 m.p.h. at 10,000 ft. and losing 13 min. at each stop will actually make good an overall speed of only 78 m.p.h.—whereas an airplane with 30 miles less cruising speed but losing only 7 min. at each stop instead of 13 would make a good 95 m.p.h. Twenty per cent of the total elapsed time would be saved by the slower airplane spending less time on the ground and in the maneuvers incident to approach and take-off.

Helicopter Operation

In all this discussion the fixed-wing airplane has been particularly in mind, but much of what has been said will apply with equal force to the helicopter. The helicopter presents no problem of runway length, and none of taxiing time. It will operate safely at low altitudes. If the time during which the aircraft is standing at the ramp for discharge and loading of passengers and goods can actually be reduced to from 30 sec. to 1 min., the helicopter's total loss of time at each stop certainly should not exceed 3 min. In Fig. 5 I have plotted against distance the average overall speed for:

(1) An airplane with a cruising speed of 180 m.p.h. at 10,000 ft., losing 7 min. for each stop as compared with the time for straight cruising.

(2) The helicopter with a cruising speed at low altitudes of 100 m.p.h., losing 2.5 min. for each stop.

Although any attempt to predict comparative performance is necessarily highly speculative in the present early stage of the helicopter art, the two sets of characteristics are chosen as likely to represent approximate equivalents in pay-load-carrying capacity per horsepower and in ratio of pay load to gross load.

On this basis of comparison the helicopter would have the advantage only on flights of less than 17 miles in length; but it has, of course, another advantage in its expected ability to use landing places so small that they can be available in congested urban areas. If the helicopter can save the average traveler 20 min. at the termini of his trip through eliminating the travel to and from airports, travelers by local service would typically make better overall speed for their journeys by using the helicopter over practically any distance within the "local" category—at least up to 150 or 200 miles, depending on how frequently the intermediate stops are spaced.

The economics of the helicopter will present many questions that are as yet unanswered, and they cannot be answered until the technical development is much more advanced. But if no serious technical difficulty and no barrier of excessive operating costs develops, it at least appears that for a considerable portion of the possible local transport routes the helicopter's shortcomings in speed as compared with the airplane will be substantially offset by its advantages in the saving of time on the ground and in certain phases of flight and in saving in travel time to the airport.

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Aircraft Size and Unit Cost

In considering the second special equipment problem of the local route —that of the economy of operation of aircraft designed for light loads—we can again draw heavily on actual experience. Air transport operations for the four years 1938–1941 (excluding the period in which costs have been deeply affected by war) have included aircraft of various sizes approximately as shown by the following table:

Number of Seats	Miles Flown During the Period 1938–1941
21	280,000,000
14	45,000,000
10	60,000,000
6	2,000,000

The figures of actual cost for the various types of equipment in the hands of various carriers have been corrected as far as possible for such variables as the year-to-year trend in costs and the effect of geography, terrain, load factor, and volume of operation. The several types included in the examination represent nearly enough the same stage of the development of the art of design to be reasonably comparable in that respect. The points representing relative total cost for the four sizes lie close to the smooth curve given in Fig. 6. Total cost* is then converted into cost per seat-mile, also plotted on the same sheet.

The curves do not present a promising outlook for the small aircraft in service to local communities. To show how unpromising it might be, Figs. 3 and 6 should be taken in combination.

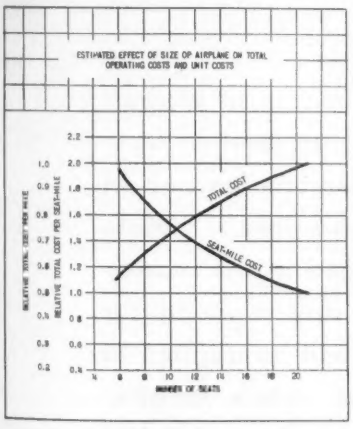

Fig. 6.

Rates of Fare

Their combined effect would indicate a necessary rate of fare on ten-passenger aircraft stopping every 30 miles about 80 per cent higher than on 21 passenger aircraft making one stop every 100 miles. The minimum practicable level of fares for the DC-3 for self-support and a reasonable profit at 65 per cent load factor and prewar price level appears to be of the approximate order of 4.8 cents per mile. The corresponding figure to make the ten-passenger aircraft operating in 30-mile stages, self-supporting, in the state of the design art represented by the DC-3 and in the present state of operating technique, would appear to be about 8.6 cents per mile.

Table 13

Estimated Rate of Fare in Cents per Mile for Independence of Governmental Financial Aid, Assuming 65 Per Cent Passenger Load Factors and Assuming the Variation of Cost with Size of Aircraft to Remain as in Recent Experience

Average Distance Between Stops (Miles)	Number of Passenger Seats					
	4	6	8	12	16	20
20	10.2	8.5	7.6	6.5	5.6	4.8
30	9.4	7.8	6.9	5.9	5.1	4.4
40	9.0	7.4	6.6	5.7	4.9	4.2
60	8.7	7.2	6.4	5.5	4.7	4.0
80	8.5	7.0	6.2	5.3	4.6	3.9
100	8.3	6.9	6.1	5.2	4.5	3.9

Operating Costs

Operating costs can certainly be substantially reduced with postwar aircraft, but I do not think that we can feel any present confidence of an early reduction of costs with machines of DC-3 size to less than 80 per cent of the DC-3 level. Furthermore, the items of cost that seem most probably subject to reduction are not those that show the largest variations with length of flight or with size of aircraft, and the proportional reduction of operating cost in the small aircraft over short distances is therefore likely to be less than in 21-passenger aircraft in through service.

We may reasonably hope, on the other hand, in accordance with the previous discussion, that the costs due to intermediate stops can be substantially reduced. I believe there may well be a reduction of about a third in the slope of the curve in Fig. 4 or even more than that if the use of airports with runways long enough to eliminate taxiing becomes common. Allowing for a recovery of one-third of what is lost in present operations by frequent stops and for a 20 per cent reduction of operating costs not only in the DC-3 size but in smaller aircraft as well, it appears that it should be possible to get the rate of fare for the ten-passenger aircraft over 30-mile distances down to 6.4 cents per mile. This figure is of enough interest to be supplemented by similar calculations for some other sizes and distances (see Table 13).

Undoubtedly there are many local routes on which higher rates of fare per mile than would be practicable in the through services can be charged without unduly attenuating the patronage. Those are the cases in which the competition of ground transportation is least effective. Where ground transportation is reasonably good, on the other hand, normal railroad fares of about 2.2 cents per airplane mile and bus fares of only a little more than half that (at prewar levels) are likely to make it difficult to develop more than a thin trickle of luxury traffic and traffic of extreme urgency, or true "feeder" traffic coming from a short distance to make connections at the airport, at rates of over 5 or 6 cents per mile. If 6 cents be taken as the limit for a self-supporting operation in 20-mile stages, it would only be possible on routes providing an average passenger load of nine or more while the corresponding minimum limit of load to support service between points 60 miles apart would be six. At a rate of fare of 5 cents a mile, the corresponding figures would be twelve and ten.

I have previously outlined a system of local routes that would call for about 350,000,000 miles of operation per year, and I have offered the estimate that if such a system were placed in operation after the war its average passenger load would be of the order of six passengers. My anticipation on that point was based on an assumption that rates of fare would at least be no higher than those now existing; and, if local routes were actually to be limited to the cases in which the relation between rate of fare and average load at least met the specifications for self-support derived in the previous paragraph, I should not expect that the opportunity would exist for flying more than about 8,000,000 or 10,000,000 miles a year on such routes under such conditions during the years immediately following the war. If local routes, depending primarily on traffic originating or terminating at relatively small cities, are to be of much importance in the national air transport network, it will then be necessary either to have substantial Governmental support of such routes or to get the total costs for operating small aircraft in short-haul transport service down to well below the present level.

The importance of reducing the slope of the curve of unit cost against size, as of that of cost against distance between stops, is manifest. The rate and extent of the development of local service will depend largely upon the success that is gained in that endeavor. To see how much reduction may be hoped for, the various elements of cost have to be considered separately. One large element in increasing the unit operating cost of small aircraft is, of course, the pay of flight crews. The size of the aircraft plays no part in determining the pay under the rules established by the Civil Aeronautics Act, and the cost per seat-mile accordingly varies inversely with capacity. That factor

* Wherever total costs are referred to herein it includes all overhead, traffic expenses, etc.

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In the skies over global battlefronts and on the boards of aircraft designers, America has fighter and bomber planes that serve as forerunners of a new great Age of Flight, when the lessons learned in the crucible of conflict will be turned to constructive uses. ¶ More than half of Delco-Remy's facilities are now engaged in the manufacture of aircraft electrical units, precision parts and products for military planes. In days to come, this equipment will be applied to meeting the requirements of commercial planes, while smaller Delco-Remy units will provide the convenience and dependability of electric starting, lighting and ignition for private planes.

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alone accounts for about 30 per cent of the variation with size as shown in Fig. 6.

Ground Operations Expense

Bracketed with this item in importance is the general category of ground operations expense. Before the distribution of expenses had been distorted by the war, ground operations amounted to about 20 per cent of the total cost of operating with DC-3's. The maintenance and depreciation of ground equipment contributed another 3 per cent. Many of the items that make up these totals are virtually independent of the size of the aircraft operated, being governed only by the mileage flown and the number of stops made. Obviously, it takes no more ground radio operators, for example, to handle a given number of flights by 20-passenger aircraft on a given route than to handle the same amount and type of operation by machines of six-passenger capacity. It is probable that about 80 per cent of the ground expense, which would be about 15 per cent of the average total cost of running a DC-3, can be considered as independent of size. To that extent, the contribution to cost per seat-mile would vary inversely as size. Ground costs would then appear to explain about another 30 per cent of the slope of the curve of total cost or even a little more than that.

Two-thirds of the total slope is thus accounted for. The remainder would be made up of a miscellany of small items. From 5 to 10 per cent is probably accounted for by fuel cost; about the same or a bit more, by the maintenance costs, which increase in total amount less rapidly than the size of the aircraft increases and in respect of some items (instruments, basic radio equipment, etc.) do not change with size at all. The figures are not so exact as to justify an attempt to trace the smaller fractions or to make the approximations given add up exactly to 100 per cent.

Some possibilities of substantial saving are obvious. Thus, if small aircraft on local runs can be operated by a single pilot, it would reduce the total costs by approximately 4 per cent for a ten-passenger airplane and 6 per cent for one of six-passenger capacity. There are other relaxations of regulatory standard which may be considered for short-range operation by small machines. Any simplification of ground organization and reduction in the number of full-time employees required at intermediate points will have its largest relative effect on cost in the smallest aircraft.

Something may also be done through the design of the aircraft. The structural penalty of light wing loading decreases in relative importance with decrease of size; and, when allowance is made for the great advantage of any reduction in the time lost incident to each stop, by reducing turning radius or accelerating take-off and climb or shortening the landing run, it may appear advantageous to build for local operation with wing loadings substantially lighter than could possibly be considered for the existing type of transport service. Other possibilities, some of which have already been mentioned in connection with the problems of expeditious ground handling, will develop as the requirements receive the specialized study that they deserve.

In the aggregate I believe it is reasonable to hope that each of the hypothetic rates of fare (Table 13) can be reduced by about one-third of the amount by which it exceeded $4^1/_2$ cents. Using that rule of thumb for estimating progress within a short term (say, within 2 years after the end of the war), the minimum average loads compatible with independence of Government aid at a rate of fare of 6 cents per mile could be brought down to 7 for 20-mile flights and $4^1/_2$ for 60-mile intervals. It is, of course, my earnest hope that the actual performance will be substantially better than that and within less time than I have suggested, but I cannot feel confident that it will. If in fact that much improvement were to be made, the 8,000,000 or 10,000,000 miles a year of truly local operation that I had previously suggested as likely to be capable of self-support under the conditions previously contemplated might be raised to 25,000,000 miles a year or more.

Perhaps it would have been wiser to have risked no numerical prediction, but I am sure that if the design and economical operation of ten-passenger aircraft in local service benefits by half the amount of study and labor that have gone into perfecting the DC-3 and developing the technique of operating it, substantial improvements can be made in the seat-mile costs that now appear so forbidding.

There is one possible economy, frequently proposed, which I do not accept. It has been suggested that local routes need not be equipped for instrument operation, that they may be limited to daytime service, and that large savings in instrumental requirements and in radio installation and personnel can thereby be made. I cannot agree that local service can be developed into a serious adjunct of the transportation system, except perhaps in a few regions that are particularly favored climatically if it is kept to a day-contact basis. Reliability is important in every form of transportation, and it will be important in local travel by air. Commuting by air, for example, obviously is not going to attract a large patronage, except during the summer months, if winter users must expect to fail to reach their offices about one day a week because of a low overcast somewhere along the route, or if they must leave for home well before five in the afternoon to avoid being caught by the dark. There would undoubtedly be many areas in which, at least at some seasons, a pure contact operation would be of enough value to justify its establishment; but as a branch of transportation, judged by the same standards as the alternative forms with which it competes for traffic, so limited a service would be a poor expedient. There again, of course, the helicopter would have an advantage; as it should be able to operate contact across country, even if at a somewhat reduced speed, under conditions that would be impossible for the airplane.

Conclusion

The two main parts into which I have divided this paper have been in some degree contradictory. The first, concerned with potential traffic and with the possible extent of local operation, glowed with an optimism conditioned only by the reminder that in order to realize the possibilities the service must be established on terms reasonably approaching the terms offered by its surface competitors. The second part, treating technical and economic factors, has emphasized the threat of unacceptably high costs, except in the limited number of cases providing pay loads heavy enough to support large aircraft, and the importance and complexity of the technical and operating problems that are yet to be solved. The opportunity certainly exists, but it is equally certain that it must be worked for if it is to be won.

Changes of Address

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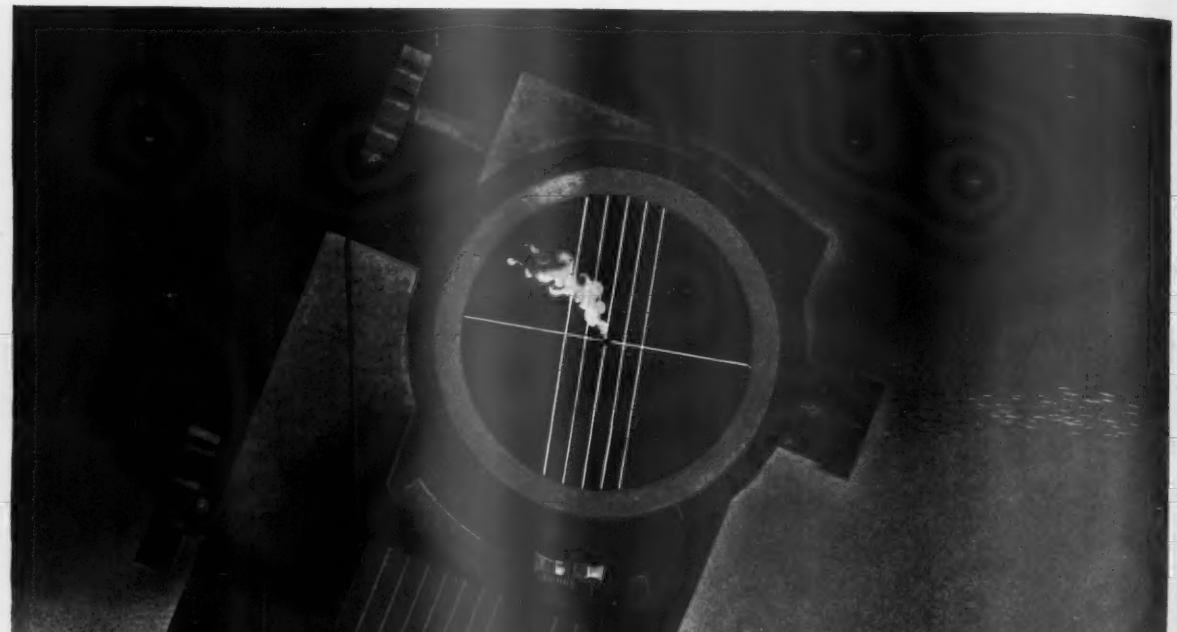

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KOLLSMAN AIRCRAFT INSTRUMENTS

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Industrial Training

LEONARD WEISS,* PETER LUBIN,† and RICHARD T. EVERILL†

Brewster Aeronautical Corporation

Introduction

A TRAINING DEPARTMENT in any company should function on the premise that "there is a job to be done." It is primarily a service department whose purpose is to assist the company in meeting its obligations by providing a supply of qualified employees. In general, it teaches employees what they need to know to do and understand their work, it teaches them what they need to know to advance, and it keeps a record of the progress of the individual employee in knowledge and skills as a basis for possible promotions.

All aircraft companies today are faced with similar specific training needs. These needs have been expressed often enough—man-power shortages, bottlenecks and delays caused by inefficient and poorly trained personnel, a demand for greater labor utilization, increased production requirements, and production and design changes with their attendant difficulties. Other problems at hand, such as cancellation and renegotiation of contracts and increasing absenteeism, may be regarded as particularly acute evidences of specific training needs today.

Specific Training Need

The term "specific training need" must occur frequently in any discussion of training, for it is the very reason for the existence of a training program. At the very beginning a distinction should be drawn between training and education. *Education* may be defined as knowledge or the process of imparting knowledge of which the application is not limited to performance of a specific task or job. *Training*, on the other hand, is a process of imparting and developing knowledge, attitudes, skills, and habits necessary to the performance of a specific task or job. As used herein, it covers both education and training inasmuch as the educational activities of a training department are confined to those that aid in performing the company's work.

The criterion that must always be used in testing a prospective training program or specific course is the question, "Is there a specific training need?" If the answer is "yes," it can be assumed that there is a reasonable basis for continuing the investigation. If the answer is "no," the request must be viewed with suspicion. Time is of the essence today. There is no place for

Leonard Weiss.

educational window dressing in any industrial-training program. Swamped as industry is with inexperienced help, supervised by men who are perhaps in key positions because they were part of the mushroom growth of a company, and faced with heavy replacement demands by Selective Service, companies have no time for anything but essential training courses. Any training program, if it is to be a success, must be constructed with these limitations in mind.

Necessary Assumptions

It is necessary to make several assumptions in formulating a training program. The first should be that all training activities in the company are to be supervised by the official training program. The reason for this is obvious, inasmuch as a division of authority will serve only to create confusion and duplication of effort. All instruction in the company is to be regarded as training—whether on the job or off the job, whether for one lecture of an hour's duration or for two years' instruction on the college level. It is also necessary to assume that the average company wants to do the job as quickly and as economically as possible using, wherever possible, funds available in the public agencies. Follow-up of training activities should be provided as an integral part of the training program. This is useful not only in evaluating the training but in inducting the worker in his new job, so that the effectiveness of the training is not lost in the attendant confusion of assuming a new position. Finally, it must be assumed that training of any nature costs money and must be accounted for eventually.

General Limitations

There are several limitations to be discussed when forming a training program. To begin with, consideration must be given the evidences of specific training needs as they are brought to the attention of the training director or are uncovered by the training director and brought to the attention of the department supervisor. (The impetus to institute training may come from either direction.) A few specific evidences of need for training can be listed as: (1) failure to meet schedules, (2) high rate of spoiled work, (3) poor safety record, (4) poor morale in department, and (5) lack of job knowledge.

Usually the need for training is not obscure. On the contrary, there are ordinarily more requests for training, formal or informal, than can readily be filled. In establishing training courses it must be the duty of the training director to decide where training will do the most good—that is, will help most to speed production. "First things first" should be his motto.

Finally, precaution should be taken to avoid overtraining. If the training department provides a surplus of trained personnel it may create discontent. Training should not be carried on for jobs that do not exist. Future needs should be ascertained when planning the training program.

Physical Limitations

From the physical standpoint the problem of fulfilling a training request is not an easy one. Where necessary, classrooms should be constructed in available space within a plant. These rooms should be conveniently accessible to all employees scheduled to undergo training. The possibility of locating the training center away from the plant should not be overlooked if it will bring a ready solution to the problem. If a scatter chart, for example, shows that 20 people who want shop mathematics live in a town 20 miles from the plant, and the course is planned for after hours, it might be well to consider giving the course at the home-town high school. This will eliminate transportation difficulties for employees sharing rides with neighbors. On the other hand, in handling the registration of an E.S.M.W.T. (Engineering, Science, and Management War Training) course the training department should not overlook the possibility of bringing the course to the plant if it will save the students time and travel. Careful surveys to ease such difficulties will

* Training Director.

† Administrative Assistants.

This advertisement is one of a series which is appearing in national magazines and newspapers as Consolidated Vultee's contribution toward a clearer public understanding of transportation's role in the war, and its postwar opportunities and responsibilities.

"Axis air base falls to Allies"... Now what?

WHEN YOU READ that Allied paratroops have captured another enemy air base, don't be too quick to say, "Now, by using this new base, our bombers can strike even deeper into the heart of industrial Germany."

It's not quite so simple as that. An Axis air base doesn't become an Allied air base merely because it has been wrested from the enemy.

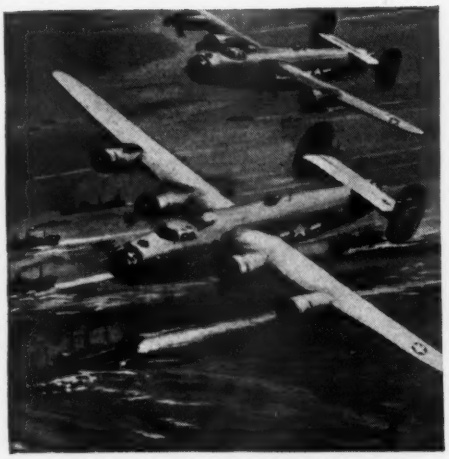
Before a single bomber can take off with its load of block-busters, there is a colossal job to be done — a job which requires the combined efforts of the airplane, the truck, the train, and the ship. That's something the communiques never tell you about . . .

1. **First come** the air-borne reinforcement troops, landing on the bomb-pocked runways. Then a second wave of planes, carrying an aviation engineer battalion, "pee-wee" tractors, scrapers, and lightweight construction equipment. An emergency landing strip is smoothed off for fighter planes, and transport planes with heavier tractors, scrapers, and rollers.

2. **Then,** the trucks come in, with gasoline and oil drums, bombs, and food. Others lug in heavy cement mixers, giant bulldozers, and tumble-buggies — so that the engineer battalions can build permanent runways for all-weather bomber operation. By this time, transport planes have flown in carrying operational personnel, radio equipment, spare bomber engines and parts.

3. **Now the heavy sluggers roar in** — the big, long-range Liberators and their crews. Transports fly in, too, bringing the ground crews who will ready the bombers for action. At last — perhaps weeks after the air base fell into our hands — the Bomber Command is ready to strike. How hard can it strike — and how long? That all depends on the vital link in the chain . . .

CONSOLIDATED VULTEE



4. This link is the never-ending stream of cargo ships. For the problem of supply cannot be solved by air alone. Transporting the equipment needed to *keep* a bomber base in operation is a job in which everything that rolls, floats, and flies must join forces.

The way this challenge has been met is more than a heroic saga in the tightening of the air ring about the Axis. It is a lesson we must remember for the peacetime years that lie ahead.

5. An enduring peace will depend, in great part, on the unhampered interchange of people, goods, and ideas between the nations of the earth.

And while all forms of transportation are teaming up to meet this postwar challenge, the plane, for one, must play a second, and possibly an even more important role: *that of policing this 60-hour-wide world.*

For the maintenance of an adequate Air Force, for years to come, will be one of the cheapest premiums America could possibly pay for insuring the peace which we shall have won.

Quick Facts for Air-Minded Readers

No ice needed — *Much of the nation's perishable commodities, such as fish, fruit, meat, and flowers, may be transported by air, someday soon. In a plane flying above 20,000 feet, no refrigeration would be required.*

• • •

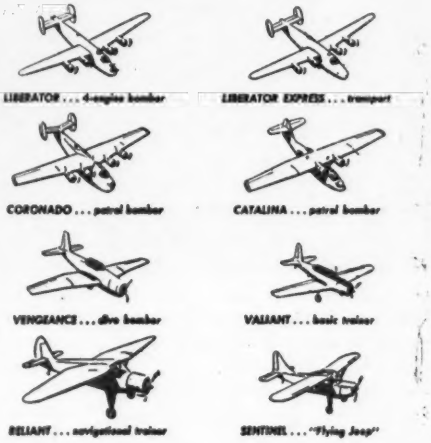
Speed, not cost — The Air Transport Command, using such planes as the huge, long-range Liberator Express, is daily flying hundreds of tons of vital equipment over our global skyways. Speed, not cost, is the all-important thing when our fighting men need blood plasma, more ammunition, or replacement parts. By plane, they get these things in a matter of *hours*, not days or weeks. In the postwar period, as planes are still further improved and new economies are effected, low rates will make commercial air freight practical for many products.

• • •

Exit the iron horse? "I have no illusions that the airplane will make the railroads obsolete. On the contrary, there will be room and plenty of need after the war for more and better transportation by rail, highway, water, and air." — TOM M. GIRDLER, Chairman of the Board, Consolidated Vultee Aircraft Corp.

No spot on earth is more than 60 hours' flying time from your local airport

From Flying Jeeps to Leviathans of the air — *Consolidated Vultee now builds many types of war planes, from small trainers to long-range bombers. When peace comes, the company will be in a position to provide the postwar equivalent of such planes, from small privately owned "air flivvers" to huge transoceanic passenger-and-cargo planes.*


LIBERATOR . . . 4-engine bomber
LIBERATOR EXPRESS . . . transport
CORONADO . . . patrol bomber
CATALINA . . . patrol bomber
VENGEANCE . . . dive bomber
VALIANT . . . basic trainer
RELIANT . . . navigational trainer
SENTINEL . . . "Flying Jeep"

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San Diego, Calif. Vultee Field, Calif. Tucson, Ariz. Fort Worth, Texas New Orleans, La. Louisville, Ky. Wayne, Mich. Dearborn, Mich. Allentown, Pa. Nashville, Tenn. Elizabeth City, N. C. Miami, Fla.

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For war today...for all flyers tomorrow!

EVEN the best grades of aviation gasoline generally available only a few years ago wouldn't be worth a hoot to a modern plane in combat.

In fact, the performance of the mighty engines of these planes is only made possible by development of an entirely new fuel.

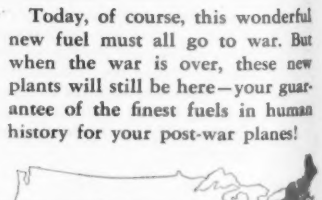
You know it as "100-octane aviation gas." But it is actually considerably higher in performance value—a true super-fuel and super-difficult to make.

Yet oceans of this new super-fuel *are* being made, right now. Every refinery shown here is doing its part. So far in the war, *one in every four* British and American combat planes has flown on aviation fuel from these refineries.

Known as "fluid catalytic cracking units," they are designed around special processes developed by Esso. What they do to petroleum sounds almost like magic even to an oil chemist.

It is simple truth that no process or company in the world, so far as we know, has ever surpassed the products these plants can turn out.

Today, of course, this wonderful new fuel must all go to war. But when the war is over, these new plants will still be here—your guarantee of the finest fuels in human history for your post-war planes!



THE FIRST "E" AWARDED TO PETROLEUM RESEARCH WORKERS was made to Esso Laboratories, Bayway, N. J.

(THIS MESSAGE HAS BEEN REVIEWED IN FULL BY THE ARMY AND NAVY, WHICH HAVE NO OBJECTION TO ITS PUBLICATION)

New employees are instructed in the use of safety devices.

earn the appreciation of the company personnel.

Psychologic Limitations

There are many psychologic limitations to be considered, particularly in these days of long work hours. First of all, the instructor must never be allowed to forget that he is dealing with mixed mental levels in almost any industrial training class. The training director and his assistants can never be too vigilant in keeping this fact before the instructional staff. The advancement of the group as a whole, rather than the spectacular development of a few individuals, is the primary assignment of the teacher. Second, the matter of class hours for persons who have put in a 10-hour day in the shop must be given careful thought. It is now generally thought that more than two sessions a week is too much for the average industrial trainee. It is also generally felt that class sessions should not run more than 2 hours. Although this is at variance with state and federal requirements in some sections, many training men feel that every effort should be made to limit any class period to a maximum duration of 2 hours. In this connection, it has also been found that classes scheduled early in the week are more successful than those arranged for later in the week. Friday and Saturday classes should be avoided whenever possible, except perhaps for one-session classes of 1 hour's length.

If the training course is to be given on company time, classes should be scheduled for early in the day. Two hours after starting work is an ideal time for a class to begin and a second choice is for a period beginning 1 hour after lunch. Classes given off company time for night-shift employees are usually scheduled for a period shortly before their starting time with approximately $^1/_2$ hour or less leeway. Off-time classes for the day-shift employees (and in some instances night-shift workers) may start immediately after the termination of the working period with only a short time allowance for some refreshment.

Existing Facilitifs for Industrial Training

Assuming that training of any sort costs money and that the average company is vitally interested in using the public facilities whenever and wherever possible, it might be well to review just what is available to a company in the United States and how these facilities may be used. The following facilities are available for industrial training: (a) local boards of education, (b) state departments of education, (c) E.S.M.-W.T., (d) "Training Within Industry," (e) Industrial Service Bureau, and the like, and (f) apprenticeship training —War Manpower Commission.

Board of Education

The local boards of education are the first source to examine for aid in vocational and supplementary training. The U.S. Office of Education has funds available which are distributed through the various states for such training as will assist in the production of war materials. When a specific need has been ascertained, a letter requesting the course required should be directed to the local board of education, stating the specific instructional material to be included in the course and telling just how this course will aid production. This will be the basis for action on the part of the board of education.

Once permission for the course has been established, thought must be given to the detailed course of study. The most successful course will be constructed with the full collaboration of instructors and company men. The courses should be checked with the supervisors in the shop to make certain that the material has specific bearing on the job requirements. If the shop men decide against a certain portion of the course, it should be considered for elimination; if they suggest additional material or stress one particular section of the course, attempts should be made to incorporate their suggestions in the course of study. Usually the instructors are only too willing to follow such recommendations.

State Department of Education

There are other sources of training available through the state department of education which are frequently overlooked. Perhaps one such aid will serve as an illustration of these training facilities. The rehabilitation services of most states are constantly on the lookout for employment opportunities for persons under their care. Since many companies are using the physically handicapped with great success, other companies may wish to seize the opportunity to have such persons trained for specific jobs in their shops. Such companies will find that the state department of rehabilitation will cooperate with them to fill specific training needs. For example, milling-machine or lathe operators can be trained at state expense to fill a job in the factory when the training is completed.

In this regard, the company should not overlook the possibility of securing instructors from the state or local board of education for instruction within the plant if it is decided that it is necessary to do the training in the shop. In most cases there is no need for a company to maintain a large force of instructors on its pay roll. If it is desired, men from within the company may be certificated to act as instructors. Follow-up instructors are also available, or men from the shop may be certificated to act as follow-up instructors.

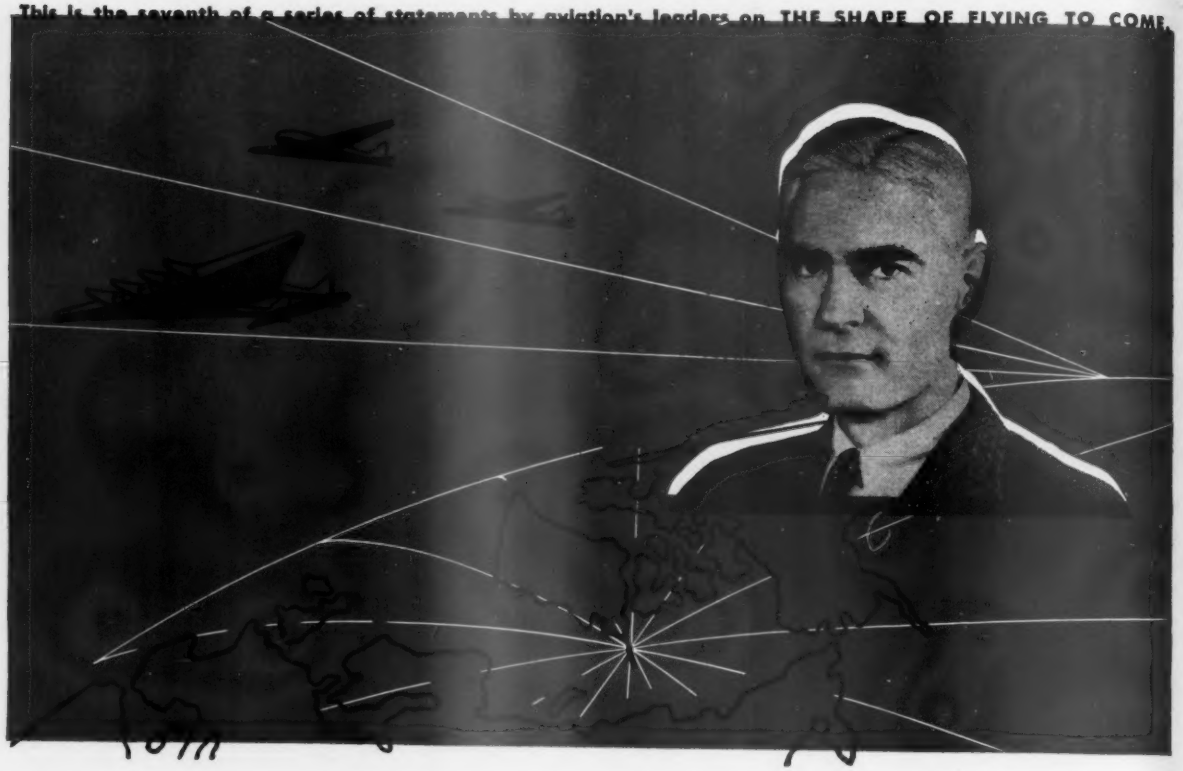
E.S.M.W.T.

The Engineering, Science, and Management War Training program of the colleges and universities of the United States has been a tremendous help to the aircraft industry. When a specific training need exists, it is not difficult to find a college or the extension division of a college to train personnel. The scope of these courses is wide, as the title suggests. When the area E.S.M.-W.T. bulletin is published, adequate copies should be secured and circulated to all bulletin boards in the plants.

Application blanks for these courses should be provided to all supervisors. This not only encourages registration in courses but also gives the training department some idea of the interest in particular courses.

If there is sufficient interest in any particular course, the training department may try to bring the course to the plant. If there is a real need for a

This is the seventh of a series of statements by aviation's leaders on THE SHAPE OF FLYING TO COME.



"Aviation will harness nature—unite the world"

Says J. CARLTON WARD, President of Fairchild Engine & Airplane Corporation:

"THOSE OF US *who have seen the changes wrought in our world, and in our habits of living, by advances in science and technology, realize that new fields of knowledge being developed by scientists in our laboratories, and applied by our industrial leaders and workers, will bring about still greater changes during the years to come.*

"The art of flying for pleasure and commerce should build vast new industries in all major countries . . . may revolutionize rural life in America during the next decade . . . will write a completely new chapter in man's harnessing of natural forces.

"And the improved transportation, the better communication, the broader understanding that will result from this should create freer, happier lives for the masses of humanity."

• • •

THUS MR. WARD describes the multiple promise of tomorrow's age of flight. But it is a promise which cannot be fulfilled by the aviation industry alone. It needs the support of a waiting "test-pilot market" as well—a market of people who (in business or in private living) are habitually first to accept any change for the better.

This is the market aviation thinks of when it thinks of the more than a million TIME-reading families—people with the foresight, income and influence that aviation needs to sponsor its programs—(people able to support with their patronage and prestige any business which executives now in aviation may enter after the war).

[Believing that the ideas of aviation's leaders are always of interest to the aviation industry, TIME here gives them wider circulation in the name of]

AVIATION'S SILENT PARTNERS

TIME

THE READERS OF TIME

course, it may be considered by the training director for scheduling on company time in the plant. If Army or Navy approval is necessary, the need must be proved and the course should be tailored to suit the needs of the company. It is well to consider tailoring every course given by the training department, whether supplementary, preindustrial, or E.S.M.W.T. The colleges, as well as the local schools, are usually willing to cooperate with the company in making the instruction specific to fit individual needs.

Training directors should not feel restricted by the published list of courses issued by the local coordinator of the E.S.M.W.T. program. Other courses may be available. If the area coordinator is contacted he may be able to supply just the course the company needs. There is a complete list of all courses available throughout the United States which may be obtained from the Office of Education. Information may be requested on the syllabus for any of these courses.

"Training Within Industry"

The War Manpower Commission has developed a training program for industry which is now well known and has been succesful in every part of the United States and in every conceivable branch of industry. Training Within Industry offers quick instruction in three courses of 10 hours' duration each. It is the effective way of reaching the greatest number of people in the shortest amount of time.

Job Instructor Training aims to train instructors to show others how to do various jobs. It is based on the premise that the average supervisor has plenty of "know-how" but just does not put this information across to his worker. It works on the principle that if the worker has not learned, the instructor has not taught.

Job Methods Training is another 10-hour course to promote the more effective use of available men, materials, and machines. The questions asked about every operation in the shop are:

(1) "Why is it necessary?"
(2) "What is its purpose?"
(3) "Where should it be done?"
(4) "When should it be done?"
(5) "Who is best qualified to do it?"
(6) "How is the best way to do it?"

Job Relations Training teaches supervisors how to get along with their workers. It develops their skill in handling their everyday human-relations problems and makes for sound job relations.

This Training-Within-Industry series is admittedly a quick course in supervisory training, but its value is great even though its length is brief.

Industrial Service Bureau

In several states there are facilities equivalent to the Industrial Service Bureau of New York which offer supervisory training at no cost to the company. The Industrial Service Bureau uses the conference method as the standard form of instruction. This technique is intended to encourage individual and group thinking about things for which there are no set answers. The use of this technique should encourage supervisors to become analytical in their approach to problems.

A course of study in Elementary Aircraft Inspection and Blueprint Reading.

The ideal group has from twelve to 18 members. Such subjects as the following are discussed and developed: (1) responsibilities of a foreman, (2) avoiding idle time, (3) maintaining discipline, (4) putting the right worker in the right job, (5) giving orders, (6) accident prevention and safety, (7) planning, (8) cooperation, (9) the foreman as instructor, (10) care of materials, tools, and equipment, (11) etc.

Such courses in foremanship are also available through the extension departments of state universities. The course of study embraces parallel subjects offered by costly private training plans. There is no need to pay high sums for training supervisory personnel when this training is available from the public agencies.

Apprenticeship Training

Another aspect of the War Manpower Commission training is the promotion of the apprenticeship training. This is often overlooked today since the accent is on the thousands of men and women needed at once in the shops for jobs that have been broken down to a degree unheard of a few years ago. However, there will always be a need for skilled mechanics with all-round training to provide replacements for foremen, skilled tool and jig makers, etc. A comprehensive training program must include a plan for replacing the older men to provide for the eventuality of a long war and to strengthen the company for postwar years. Inasmuch as young tool makers are scarce today the program must also make provision for the training and development of women.

All above facilities are available in the United States. If difficulty is experienced in securing information, the state director of vocational education stands ready to help, and the U.S. Office of Education is always open to suggestions on improvements, modifications, or expansion of existing training programs.

Procedure for Setting Up a Training Course

As a practical illustration it might be well to trace the development of one course of study to establish a general pattern of procedure for the institution of training courses. Let us assume that the training director has studied the Manning Table and Replacement Schedule for men to be taken by Selective Service, which give him the approximate number of men by job classification needed at any period of time.

In the case of riveters and assemblers, for example, with the number required and the date established, the training director, after conferring with the factory manager and the personnel director, can go to the local board of education and apply for the training of personnel in riveting and assembly work. He has a specific need on which to base his request.

Out-of-Plant Training

In conference with school authorities, shop men, and personnel men, the course of study is drawn to fit the job requirements of aircraft helpers in riveting and assembly. The course is tailored to give what the shop men regard as essential job instruction and practice.

The actual recruiting of trainees may be managed by the company or in cooperation with the U.S. Employment Service. The company must make the decision whether this is to be preemployment, which is unpaid training, or preindustrial paid training. The latter plan is almost mandatory today in most sections where aircraft factories are located. Under this plan the trainee becomes an employee of the company, is assigned to the school, and is given a company department number for pay-roll purposes. He is given orientation training, he acquires tools, and he punches a time clock, just as he would in a production shop. His supervisor is the training director. When his rating sheet, signed by the class instructor, indicates that he is ready to begin work, he is transferred by the training director to the shop designated to receive him. A copy of the rating sheet goes with the transfer to the foreman of the department so that he may make full use of the employee's skill. This same plan may be used for training milling-machine operators, welders, and even office help.

In-Plant and Vestibule Training

Where it is decided that vocational training is to be conducted within the company, this training may be either on or off the production floor.

If it is decided that instruction is to be carried on within the production department, this may be done by an old employee who is experienced on the work to be taught and who knows the basic principles of job instruction, by the supervisor, by a special instructor or by the understudy method. Under this method the trainee is under close supervision, works on simple production jobs, works on actual production machines, and enjoys the atmosphere of the work shop. Where necessary, the trainee may also be given classroom instruction to supplement his on-the-job training.

On the other hand, if it is decided that training is to be conducted off the production line in the company vestibule school, the actual instruction may be carried by company or outside instructors. The advantages of this system include: (1) regular production not impeded by learners, (2) closer supervision of trainee, (3) favorable atmosphere for trainee, and (4) special attention given to the weak points of each trainee.

The disadvantages are: (1) With the passing of time, vestibule school equipment and methods lag behind shop equipment and methods; (2) the vestibule school tends to underemphasize the importance of the time factor; and (3) an adjustment period is required when transferring the learner to the shop.

Necessary Records

Since one function of the training department is to keep a record of the progress of each individual employee undergoing training, an adequate system of records must be established. This need not be elaborate, but it must function to give all the necessary information when required.

Two basic records serve as the backbone of the permanent file of information: (a) record of trainees by course and (b) record of trainees by department.

Record of Trainees by Course

This consists of folders for each individual training course. Every course folder lists such essentials as the name of each trainee, clock number, job classification, department number, and attendance by date. This record immediately indicates which persons took what course, where, and at what time.

Record of Trainees by Department

This consists of a series of folders by department. Every department folder lists the persons of that department who have completed one or more training courses, reference code number of each course, trainee clock number, job classification, total attendance in manhours for each course, rate of pay and course grades. This record immediately indicates which persons in a department took what courses, where, and when.

Original registration cards can be filled out in duplicate by each trainee. All information necessary for the two records mentioned above should be called for on these cards. One card can be filed by individual course; the other card can be filed alphabetically by last name of trainee. The file of cards by course is to be maintained in an active and inactive section. When a person finishes a course his card is transferred from the active to the inactive section. Where a person registers for another training course, however, he need fill out only one card instead of two. This card is to be placed in the active file section by course and is to be used as a basis for making notation on one of the original registration cards filed alphabetically. A running attendance record is to be kept on the back of the card filed by course.

Attendance sheets should be signed by each student and prepared singly or in duplicate and triplicate if necessary. Where courses are given on company time, three copies should be prepared: one copy should be sent to the accounting department; another to government cost inspection; and the last copy retained in the training office file.

The company accounting department should accumulate all training costs by individual courses. It should also submit monthly statements of actual costs to the training director for comparison and study purposes. The accounting department on the other hand, should be supplied with pertinent data on all purchase orders and factory orders for books, equipment, visual aids, etc., submitted by the training department.

When a course is completed, a standard form should be sent to the personnel department stating that the employee has completed a specific training course. This information is to be filed in the employee's personnel record folder.

A suitable certificate should be given each student when he completes a course. Some companies use two certificates, one of traditional size, and another of card size to be carried in a wallet.

Costs

Assuming that the average company wants to keep training costs at a minimum, certain basic rules may be drawn for the guidance of training directors.

Hand-riveting trainees undergoing instruction for Brewster at the Aviation Trades Center.

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What new flight training could assure this dual objective? A new device was called for—*a team-work trainer*—for pilot, navigator, radio operator, bombardier. A celestial navigation trainer, reproducing the heavens at night. A trainer which would "fly" over valleys and mountains, which would show the moving terrain below, and yet be anchored to the ground!

Could such a device actually be contrived, and built?

The problem was given Link. Link engineering provided the answer.

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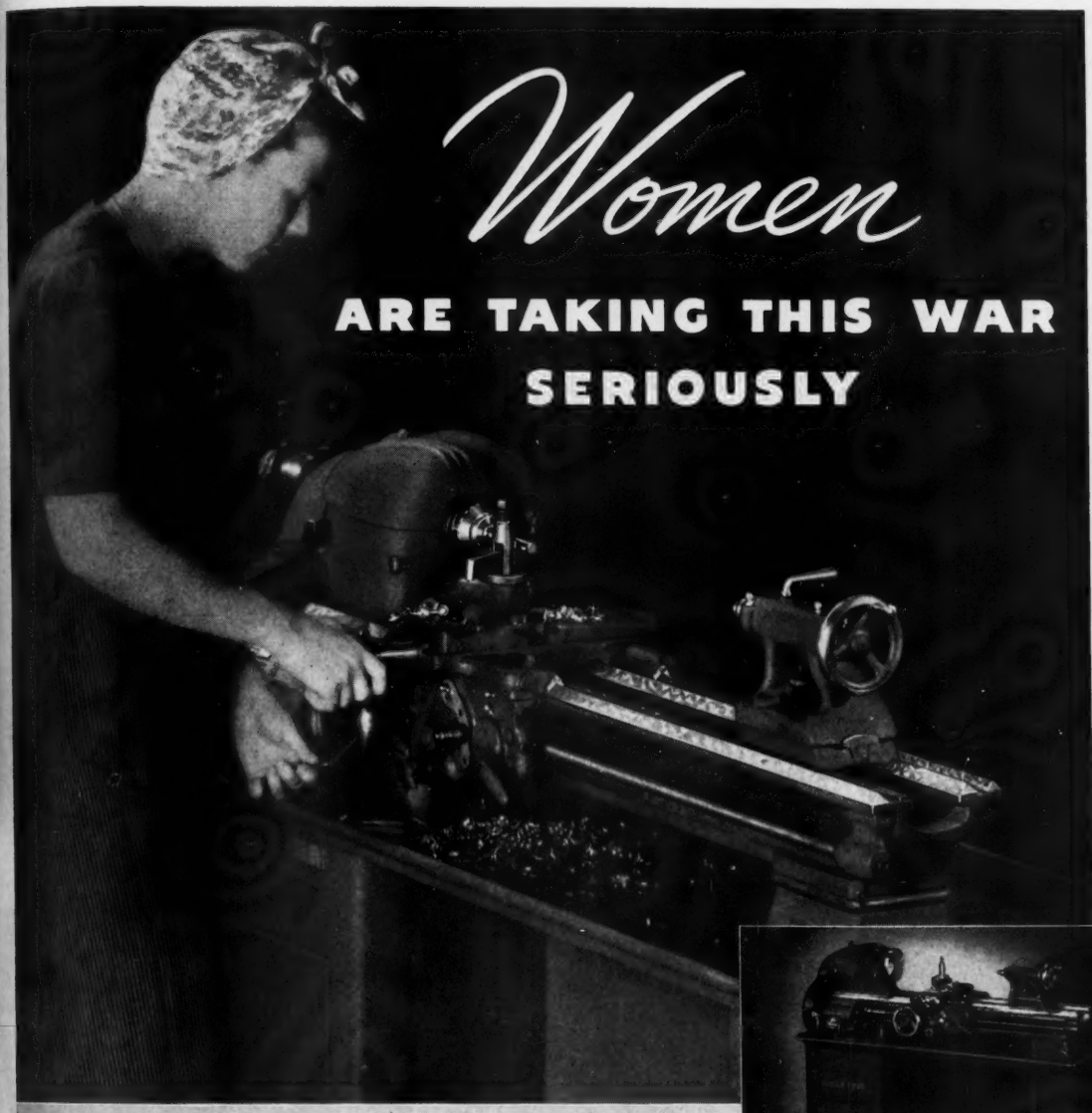

SOUTH BEND LATHES

9" swing, South Bend Engine Lathe

With grim determination thousands of American women are doing their best to fill men's shoes. Eagerly they bend their shoulders to wartime tasks—for no sacrifice is too great if it hastens the return of their men from the fighting fronts.

In hundreds of vital war plants, women are operating South Bend Lathes with surprising results. On all kinds of jobs, they have kept up production and maintained established standards of precision. In some factories whole batteries of South Bend Lathes are humming under the guidance of feminine hands.

Since World War I, women operators have preferred South Bend Lathes. Their nimble fingers find the convenient controls well suited to their sensitive touch. They like the fully enclosed design. And, most of all, they appreciate the ease of operation that prevents fatigue and makes the workday seem shorter.

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Eimac tubes are the dominant leader in the field of air transportation. Long years of successful experience, thousands of hours of dependable service have made them first choice of the leading engineers throughout the world . . . first choice of all the major airlines.

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One rule should be to examine the request for training to see if it can justify the expense involved. Although the instruction may be obtained without cost, there are always overhead costs to be considered. If the course is to be given on company time, company policy must be established about time charged to training. Perhaps the student will be charged to training for the class hours only; perhaps he will have to be charged from the time he leaves the job until he returns. Rules will also have to be established about overtime rates. If the company is working on a cost-plus-fixed-fee contract, the training director will have to be cautious about instruction given on company time and doubly cautious about overtime rates paid to persons in classes. Only in rare cases will this expenditure be approved.

Finally, he should be fully aware of what is available in the way of instruction and auxiliary training aids in public educational agencies and institutions. For example, almost all preindustrial and pre-employment training can be obtained through the state vocational education department. Supervisory training can be obtained free through the state universities and such agencies as the Industrial Service Bureau of the State of New York. The Training-Within-Industry program offers specialized training free. The E.S.M.W.T. and the state vocational education programs will provide most of the supplementary training without charge. Visual aids may be obtained from the state or the U.S. Office of Education. Thousands of dollars can be saved by a company if an alert training director gives careful study to the excellent free services available through the various federal, state, and municipal facilities.

Future Trends

Training will play an increasingly important role as the war progresses. Immediately ahead is the movement for greater labor utilization. In its own right, training affects all factors of production—men, materials, machines, methods, and morale. Skilled experienced men are being lost in greater numbers to Selective Service. Women and rehabilitated soldiers and civilians in vast numbers are needed in war jobs. And when the peace is won and conversion from war- to peacetime economy takes place, training and retraining will be necessary for newer jobs. Fierce industrial competition can be expected, and a well-established training program will be a valuable asset to any company.

An Outline for Industrial Training

Industrial Vocational Training

A. Pre-Employment Training. Training made available through the use of facilities, public and private, before an individual is hired as an employee of the company. Because of the critical labor supply and shortages of available personnel for enrollment in the public schools, this sort of training is apparently on the way out for the duration and has been replaced by paid trainee activities included in this outline under "Preindustrial Training."

B. Preindustrial Training. Training administered to employees of the company both on the job and through the use of outside school facilities. These employees are paid regular starting wages in accordance with the existing company rates. The courses are selected and administered by the company and the schools concerned. After satisfactory completion of these courses, the employees report for regular work at the plant. With this type of training, the time needed for developing skill on the job is shortened. He adjusts more readily to factory surroundings. He grasps more quickly the language of the factory, and he acquires beginner's skill.

Trainees receiving instruction on a dummy model.

C. Supplementary Training. Includes training for both the factory and nonfactory. This type of training may be carried on:

(1) In the plant by company instructors—(a) on company time and (b) after working hours.

(2) In outside schools and facilities —(a) on company time and (b) after working hours.

(3) On company property in conjunction with outside agencies—(a) on company time and (b) after working hours.

These courses may vary in length and frequency of session or course as the needs are demonstrated by the departments concerned. For instance, one course may last for only 1 hour and be forever discontinued, while another may last for 20 weeks and be repeated over a long period.

Training in the essential skills of a job is best done on the job, but the supplementary information that is a tool for a beginner's job is most often acquired off the job. Supplementary instruction is applicable at all levels of the organization and is a necessary requirement for moving from one stage to that above. Typical courses that might be offered by an aircraft company in the supplementary training program would include: blueprint reading, production control, basic inspection practices, aircraft lofting, aircraft jig and fixture design, aircraft descriptive geometry, etc.

D. Apprenticeship Training. A long-range program of training offered an employee within determined age brackets in an approved program of technical work experience, supplemented by related classroom instruction.

Orientation and Induction Program (for New Employees)

Orientation means the acquainting of the new employee with company history, company policies, general company rules and regulations, and the spirit of cooperation.

Induction means the process of introducing the new employee to his supervisors and his new place of work, and is to be associated with job instruction.

Supervisory Training

Training offered those members of the company who are in a supervisory position. Generally speaking, it covers the fundamentals of supervision and

(*Continued on page 177*)

5 *reasons why* you need x-ray for aircraft production

REASON ONE...
Saves Machine and Man-Hours

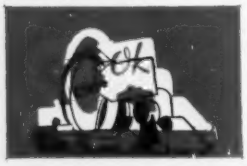
- Eliminates machining and assembly of faulty parts.
- Determines the exact location and extent of faults in products or assemblies.

REASON TWO...
Conserves Critical Materials

- Eliminates rejects. Weeds out bad units.
- Replaces "destructive" tests.

REASON THREE...
Speeds Production

- Easily quick-checks hidden assemblies.
- Permits use of high-speed manufacturing processes . . . welding, die casting.

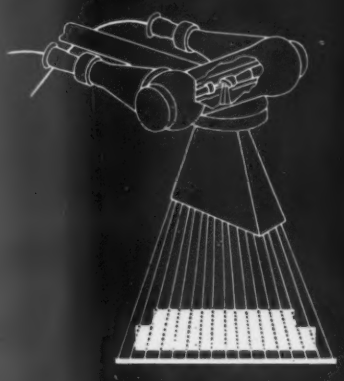


REASON FOUR...Controls Quality

- Perfects techniques quickly for quantity production.
- Keeps quality consistent by pictorial comparison or check of all completed units.

REASON FIVE...
Helps Train Workers

- Arouses worker's interest by giving him exact picture of work he is doing.
- Accurately tests worker's qualifications. Serves as basis for visual education in training.



WHY CONSIDER IT? X-ray provides the only means of non-destructive and foolproof internal inspection of parts and assemblies to control and improve quality.

War products demand it today; keen postwar competition between products and processes will demand it tomorrow.

IS IT COMPLICATED? Contrary to popular conception—no! Simplified controls, developed by Westinghouse, facilitate both training and operation.

In fact, x-ray greatly simplifies many production, design, inspection analysis jobs.

IS IT COSTLY? Like any other modern production tool, industrial x-ray justifies its purchase price by reducing production costs and waste . . . insuring uniform quality and satisfied customers.

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No. 5 FLANGE PACKINGS *(Continued)*

(Packings Pointers No. 4 discussed the advantages, design features and two typical applications of the flange packing.)

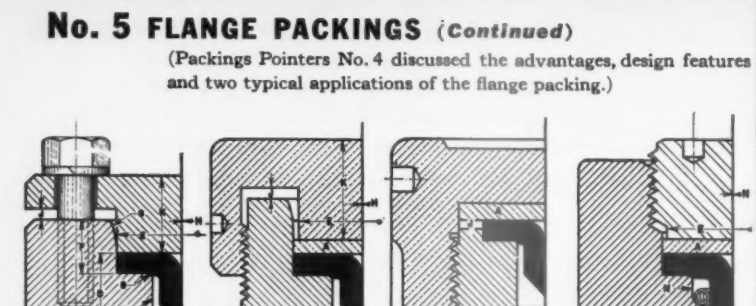


FIG. 1 FIG. 2 FIG. 3 FIG. 4

A. Methods of Attaching Gland

Bolted gland — Fig. 1

Threaded gland, nut-type — Fig. 2

Threaded gland, nut-type with shallow recess — Fig. 3

Threaded gland, screw-type — Fig. 4

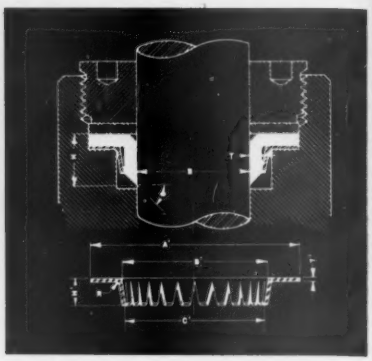
With the type of gland nut shown in Fig. 3, the recess for the base of the packing is shallower than the thickness of the packing. The recess only aids in centering the packing; it should be shallow enough at the packing's outside diameter so there will never be a metal-to-metal contact at "j".

With the type of expander shown in Fig. 4, an extra step is required in the recess at "N". The diameter at "N" should be equal to the diameter of the shaft plus twice the leather thickness plus twice the coil spring thickness plus enough clearance for easy assembly. The depth of the recess at "N" is determined by the height of the packing and the angle of the bevel, but should be deep enough to keep the spring on the outside of the packing's vertical wall, preventing it from slipping over the bevel and becoming ineffective.

Spartan Leather Packings

Graton & Knight's SPARTAN has highest resistance to heat (withstands boil test), and will not dry out hard and brittle. It is acknowledged the top-quality leather in the packings industry.

When your design reaches the "packing point" — or when a packing trouble occurs — call on G&K engineers.



(FIG. 5)

B. Expanders (actually "contractors" in the case of flanges)

1. Finger-type—Fig. 5

The finger-type expander, made from phosphor-bronze or spring steel, is the most efficient of the commonly used types for flanges, but it is usually limited to use on production jobs since its manufacture necessitates a special set of stamping and forming tools for each size of expander.

Due to the many standard variations in dimensions of flange packings, it is not advisable to attempt a set formula for the design of finger-type expander. However, the following general rule will be a helpful starting point.

A = OD of flange packing
B = OD of shaft
H = height of flange
T = thickness of flange
$H^1 = H - T - (\text{Tan. } \theta \times T)$
$A^1 = A$
$B^1 = B + 2T + 2T^1$
C^1 (in free position) = B
T^1 = optional (to be determined by the tension of the material used and the existing conditions, considering the amount of tension needed)

2. Garter-type—Fig. 4

(to be discussed in a later issue of "Packings Pointers")

C. Washer

On all threaded glands it is advisable to use a protective washer (A in Figs. 2, 3, 4) between the flange and the gland. The washer may be metal, or any other suitable material. Without the washer, the twisting action caused by tightening the gland would damage the packing.

When the washer is used, its inside diameter should be as close a fit as possible on the shaft in order to give the packing proper support. In this case, the fit between the inside diameter of the gland and the outside diameter of shaft does *not* have to be close tolerance.

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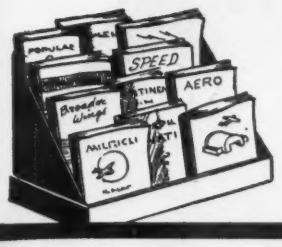

Periodicals

Accessories

Continental Improves Cowl Flaps. Conceived by Continental Air Lines' employees, an improved method of operating the engine cowl flaps of the company's Lockheed Lodestars is described and illustrated. With the new method the flaps are actuated hydraulically instead of electrically, the pilot is enabled to trail the flaps, and the necessary power to operate the flaps is provided under all conditions. In addition, substitution of a spring-mounted fiber block for one of the two small aluminum rollers supporting the flap-actuating tube eliminates vibration and reduces wear on the flap-actuating tube. *Aviation*, December, 1943, page 147, 4 illus.

Making Flying Togs for the R.C.-A.F. Gordon Sinclair. This article tells of the developments in functional flight clothing effected by the Canadian clothing firm of Deacon Brothers. Briefly reviewing the history of the company, it describes how Deacon Brothers improved on the flying suits of the Royal Air Force, designed and manufactured the general issue Type E flying suit, helped create the first double-pile fabric to take the place of sheepskin for lining, sponsored Grenfell cloth, discovered new ways of trapping insulating air within a garment, and employed quick-release zippers for pilot's suits. Different styles and colors of flying suits currently used by the British and Canadian air forces are noted. *Commercial Aviation*, November, 1943, pages 62, 64, 66, 6 illus.

Drop Tanks. Some additional data on the employment of supplementary fuel tanks that can be jettisoned after use. Demonstrating how these drop tanks increase the range of aircraft, features of their application in various airplanes and the different types of material of which they are constructed are surveyed. Installations in the Hurricane, Typhoon, Thunderbolt, Lightning, and Messerschmitt are noted particularly, while others in the Spitfire, Mustang, Mosquito, Fortress, and Liberator are mentioned. *Flight*, November 4, 1943, pages 511–513, 9 illus.

Transparent Armor . . . . Shields for Sky Fighters. The characteristics of the bullet-resistant glass used on aircraft are outlined in nontechnical terms. It is explained that, like automobile safety glass, it consists of multiple sheets of polished plate glass separated by films of transparent plastic. Reference is made to the troubles encountered with the plastics first employed for safety glass. It is stated that not long before the war chemists perfected a synthetic plastic, known as plasticized vinyl butyral, which met all objections and that bullet resistant glass was fully developed just in time for war needs. *Popular Science*, February, 1944, pages 74–77, 11 illus.

Castor Shimmy. Major O. J. Marstrand. Preceded by an explanation of the causes of oscillation in castering wheels and the forces that counteract the motion, this is a description of the Marstrand-Dunlop twin-contact tire for suppressing "shimmy." Designed to reduce the forcing effects and to increase the damping action at the ground contact area, the twin-contact tire dispenses with or reduces the amounts of damping or self-centering applied at the pivot. Its construction is said to offer a departure from previous practice only in the contour of the tread, which is molded so as to have on it two ring-shaped ridges comprising the only parts in contact with the ground. The effectiveness of this tire in preventing shimmy is based upon the reduction of the forcing effects and is attributed to three primary causes: the side stiffness of the tire, especially when in rapid rotation; the prevention of the curved walls from touching the ground; and the resistance by the two contact rings of the twisting effect relative to each other. *Flight*, November 18, 1943, pages 554, 555, 3 illus.

Aerodynamics

Loss in Aileron Effectiveness Because of Wing Twist and Considerations Regarding the Internal-Pressure Balanced Aileron. Reinhardt Rosenberg. The treatment of internal-pressure balanced ailerons in flutter analysis is indicated, and the conclusion is reached that, in contradistinction to Frise-type aileron balance, this type of aerodynamic balance does not affect the expressions for oscillatory wing lift and wing moment.

From a variation of conditions of aileron reversal, expressions for loss in aileron effectiveness at lesser speeds have been derived. It is shown, and substantiated by flight-test data, that deviations from two-dimensional flow are considerable and that past methods of computing aileron reversal speeds are highly conservative. Improvements on present methods are given and

INDEX

Accessories 65
Aerodynamics 65
Air Cargo 67
Air Power 71
Air Transport 71
Airplane Descriptions 73
Airports 74
Armament 81
Business and Finance 81
Camouflage 82
Civil Aviation 85
Companies 85
Control Equipment 85
Design 87
Electrical Equipment 89
Engines 89
Flight Technique 93
Flight Testing 94
Fuels 97
Gliding and Soaring 97
History 97
Hydraulics 97
Inspection 97
Instrument Flying 97
Instruments 98
Jet Propulsion 101
Lighter-Than-Air 101
Maintenance 101
Management 109
Materials 109
Medicine 109
Metallurgy 111
Meteorology 111
Military Aviation 111
Model Airplanes 111
Personalities 111
Personnel 112
Plants 115
Plastics and Plywood 115
Postwar Aviation 115
Production 119
Propellers 125
Radio 125
Rotating Wing Aircraft 129
Stress Analysis 129
Superchargers 131
Testing 133
Tools and Equipment 133
Training 135
Warfare 137
Welding 139
Wind Tunnels 139
Miscellaneous 139

A New Art

OF FORMING FORMICA SHEETS

War production has resulted in the development of new ways of forming completely cured Formica sheets. This method is highly successful commercially and at North American Aviation where Plastic Engineer William Beech developed it. Many parts shaped in this way, are in regular production and use.

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THE TECHNIQUE

Formica sheets are heated in an oven to a temperature somewhat higher than that at which they were cured—just under the blistering point. Then they are quickly inserted in a press with wooden or "Pregwood" forming dies and stamped into shape. When cold, the shape is permanent.

comparisons with flight test results are illustrated.

In many respects this paper was suggested by a previously published paper by a different author, but the solution for loss in maneuverability below the aileron reversal speed and the deviations from the "flutter equations" are new. *Journal of the Aeronautical Sciences*, January, 1944, pages 41–47, 62, 4 illus.

Take-Off Distance of a Glider Train. Wieslaw Z. Stepniewski. The take-off distance of a glider train is one of the most important factors in the consideration of the practical use of this kind of transport for military and perhaps future civil uses.

Some simple formulas are given in this paper, for the approximate value of the take-off distance necessary to clear an obstacle of a given altitude (50 ft.). However, when preliminary considerations are being made, there are often no complete data regarding the engine-propeller group. For this case a rough but simple method is established allowing the reader to estimate all the necessary characteristics. The primary considerations are for a glider train, in general, but the final formulas are established rather for the large transport gliders towed by planes equipped with constant-speed propellers.

It is sometimes important to know whether it is better to overload an existing plane to some possible limit or to put this additional load into a glider towed by the airplane. For this reason an example is presented which gives the ratio of the take-off distance of an overloaded plane of the DC-3 class to the take-off distance when the plane has its normal weight. A similar comparison is made for the glider train, supposing that the additional load is put into a glider towed by this plane having its normal weight. The comparison assumes that the empty weight of a transport glider plus the weight of its crew will be approximately 40 to 45 per cent of its total weight. In other words, it is understood that about 60 to 55 per cent of the gross weight of such a glider may be considered as pay load. *Journal of the Aeronautical Sciences*, January, 1944, pages 55–62, 6 illus.

A Contribution to Cascade Theory. J. Lockwood Taylor. It is stated that the theory of the flow past cascades or infinite series of airfoils, regularly spaced, is of importance in connection with the design of turbo-blower blades, interference between propeller-blade root sections, wind-tunnel circuit design, and kindred problems. The usual development of the theory involves some rather advanced applications of conformal representation which it is difficult to translate into numerical terms, and no general solution for an arbitrary form of airfoil section is available. It is shown that so far as lift interference is concerned—one of the main points on which information is required—approximate results of fairly general application can be obtained with the help of relatively simple mathematics, and the formulas lend themselves readily to numerical work. The basic principle applied is that of the direct calculation of the downwash components of the flow caused by the remaining airfoils of the cascade, somewhat on the lines of Glauert's approximate biplane interference corrections. *The Journal of The Royal Aeronautical Society*, November, 1943, pages 397–400.

The irregularity of receipt of publications from abroad necessitates the review of articles in issues several months late. This is done to provide readers with information regarding foreign technical progress as soon as the issues are available in the United States.

Design of Elbows in Potential Motion. Boleslaw Szczeniowski. The purpose of this study is the solution of the problem of the shaping of elbows, such as those used in wind tunnels, in such a way as to fulfill the equation of continuity of the fluid in a two-dimensional flow. It is shown that the shaping of the elbows is important in obtaining an even stream of fluid after the turn, without vortexes, and having a velocity as uniform as possible throughout the cross section. A solution is given for an arbitrary angle between the intersecting centerlines of a wind-tunnel shaft at an elbow, the problem being limited to the stationary, two-dimensional motion of an ideal incompressible fluid. A form of complex potential is worked out, taking into consideration all of the given conditions. Rectangular elbows are discussed, and a design for a pipe line having a circular cross section is called one of the most interesting. Information is given also on velocity ratios and on elbows with straight outer walls. *Journal of the Aeronautical Sciences*, January, 1944, pages 73–75, 5 illus.

Critical Reversal Speed. W. H. Horton. This article was written for two purposes: first, to provide a means to a quick approximate determination of the critical reversal speed of a wing; second, to give a clearer insight of why approximations can be given for the general formula for determining the reversal coefficient, when the aileron chord and wing chord are of linear taper, at least over the aileron portion. In order that it will be useful to students and other readers alike, a brief account of the phenomena of aileron reversal is given as an introduction. *Aircraft Engineering*, November, 1943, pages 319–324, 7 illus.

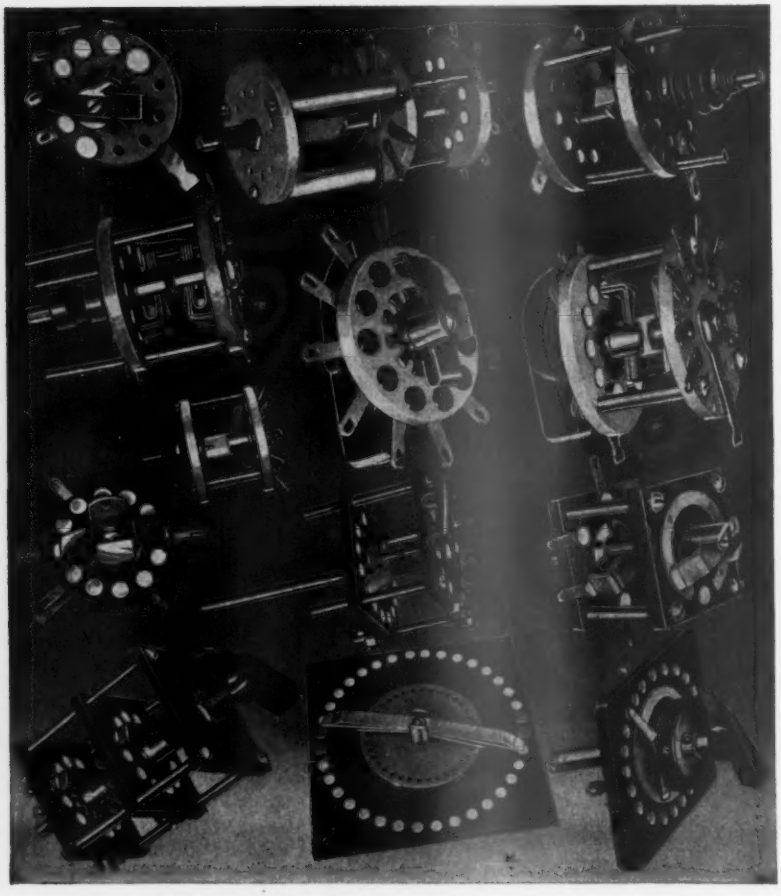
Measuring the Takeoff. Max M. Munk. Some aspects of measuring and computing the take-off performance of airplanes are studied. Comparing the take-off distance with the time required, the writer states that there is no critical time limit for the take-off but that distance is the important factor, since the length of runways and the size of the airport are the determining factors. Nevertheless, take-off performance is still measured by many engineers in time instead of distance. Although it is conceded that time can serve as an approximate measure of distance, other factors that enter into the calculation are explained and demonstrated mathematically, such as acceleration, taxiing velocity, and propeller thrust. A hypothetic example is worked out, showing the calculations for take-off duration, acceleration, take-off efficiency of the propeller, and the ratios of time and distance averages of acceleration. Take-off measurements made by the Civil Aeronautics Administration with a Douglas transport are referred to, and the need for similar data for smaller planes with fixed-pitch propellers is expressed. A wind distance meter is described and its wider use is suggested. *Aero Digest*, December, 1943, pages 242, 266, 268, 1 illus.

The Lateral Stability of Aeroplanes. H. L. Price. In this third of a series of articles on the lateral stability of aircraft, attention is given to the physical aspect of the nature of disturbed motion. Possible types of motion are discussed in greater detail. Sections are devoted to the dependence of motion on initial conditions, motion as the sum of the individual modes, the individual modes, initial motions, the application of control couples, methods of solving the equations, the control of unstable airplanes, the Heaviside operator in controlled motions, and the choice of suitable control deflections. *Aircraft Engineering*, November, 1943, pages 325–329, 2 illus.

Air Cargo

Air Freight of the Future. J. Percival Chaplin. For the promotion of future air transportation of freight, fundamental points with regard to the planning of ground facilities and designing of cargo planes are reviewed. Primary factors in the design of cargo airplanes are designated as speed, size of unit, handling efficiency, form and shape, and balance. The observation is offered that at the present stage of development aircraft ranging from 60 to 120 ft. span offer the most useful field for design. *The Aeroplane*, November 26, 1943, pages 614, 615, 5 illus.

Air Cargo. Part V. Harry S. Pack. The fifth in this series of articles on air cargo is a discussion of some handling equipment and methods designed to reduce air cargo ground costs. Among the problems considered are those of consolidating material in every way possible, sorting packages of varied freight as near the point of unloading as possible, storing materials, distributing manual labor so as to equalize the work at both ends of the operations, and de-



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livering the cargo once it is on the ground. The equipment mentioned includes fork trucks in conjunction with palletized loads, a pallet with latched "gate" for assorted parcels, a pallet with retractable rollers and strapped net, and a patented collapsible basket. Two cost studies accompany the article. One is of a local pickup and delivery operation direct from the airport and calling for one trip daily from and to the airport; the other is of a tractor-semitrailer service directly from airport to substation (distribution point) in city and vice versa. *Flying*, January, 1944, pages 5–7, 30 (Air Commerce Section), 5 illus.

Career of Cargo. M. D. Miller. The place of air shipment in the transportation business is discussed. It is stated that it is dependent on the volume of business done by producers of certain goods having a relatively high value per pound. A complicated machine with delicate parts worth several hundred dollars may be shipped by air economically because the cost of flying it per pound is a small percentage of its pound value. Perishability is a second factor determining the appropriateness of a product for air shipment. Wartime emergencies are accustoming air lines to the handling of heavy shipments. Examples of such shipments are cited. The fact that air lines handle emergency express successfully with limited equipment indicates that when more planes are available after the war carriers will have the background of experience necessary to handle the large cargo potential seen by leaders in aviation. *Airlanes*, December, 1943, pages 14, 15, 3 illus.

Packing War Material in Fiber Containers. Robert A. Cockrell. A study of the applications, effectiveness, and limitations of fiber containers for packaging war materials. Points covered include: the principal shortcomings of fiberboard; the three general types of loads into which Government agencies have classified various shipments; and the use of fiber for interior containers, exterior containers, and cushioning materials. The work of the U.S. Forest Products Laboratory in testing and developing containers for military shipments is noted. *Flying*, January, 1944, pages 10–12, 30 (Air Commerce Section), 5 illus.

"Cargoliner" Conversion. Paul Burbank. Details are given on the alterations that were made to convert three United Air Lines DC-3 passenger cargo transports into all-mail-express planes. It is related how room was made for 1,284 lbs. of additional pay load by stripping the "Mainliners" of their passenger fittings and doorways . . . . thereby obtaining planes more functionally designed for the coast-to-coast cargo service inaugerated by United Air Lines. Among other things, attention is called to the use of separating pits, special bins, protective screens on windows, floor skids, tie-down arrangements, and duralu-

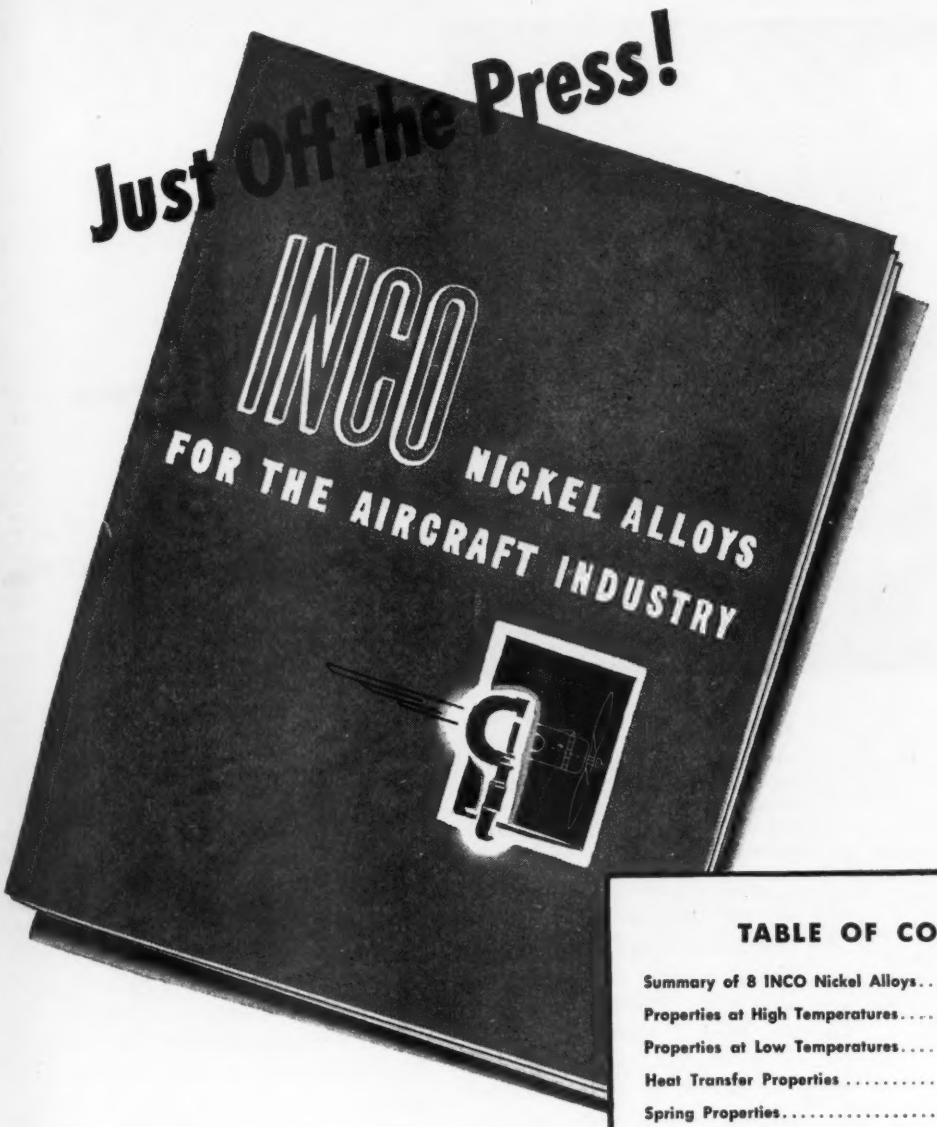

TABLE OF CONTENTS

	Pages
Summary of 8 INCO Nickel Alloys	4-5
Properties at High Temperatures	6
Properties at Low Temperatures	7
Heat Transfer Properties	8
Spring Properties	12-13
Special Mechanical Properties	9-11
Corrosion Resistance	22
Fabrication of INCO Nickel Alloys	14-15
Index to Specifications	16-21

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minum tubing to protect heater ducts. The schedule of flights for the new service and the application of systemized methods of loading are also noted. *Flying*, January, 1944, pages 16–18, 28 (Air Commerce Section), 4 illus.; "Sky Cargoes, Today and Tomorrow," by C. P. Graddick, *Flying Aces*, February, 1944, pages 10, 11, 42, 44, 5 illus.

Air Power

Air Power and Island Warfare. Capt. H. A. DeWeerd. As adopted in the New Guinea theater of operations, techniques of aerial warfare employed in island and jungle battlefields are reviewed. In addition to bombing and ground-strafing attacks on Japanese positions and lines of communication, it is related how the transportation of men and materials by air played an important part in the Papuan campaign and subsequent Pacific offensives. Patterns of aerial combat which are set by conditions of jungle fighting are described. *Flying*, January, 1944, pages 52, 53, 94, 97, 3 illus.

Air Power Versus Japan. Capt. Norman Macmillan. In this article the writer explains some of the aspects of the military employment of air power which will aid in achieving final and complete victory over the Japanese. Conditions prevailing in the Pacific war zone are reviewed and are compared with the problems of air warfare elsewhere. Methods are outlined for meeting those conditions and a detailed strategic plan is suggested for the use of American and British sea, ground, and air forces. *Aeronautics*, December, 1943, pages 28–33, 3 illus.

Hanson Baldwin Reports . . . . . Continuing his series of air-war analyses, the writer indicates the trends of combat on the Western European and Pacific fronts during the closing months of 1943. He summarizes the advantages and disadvantages of both sides in the war over Germany and gives evidence to show that Germany is not yet vitally weakened. Comparative combat qualities of American, German, and Japanese fighters and bombers are assessed. Western Europe is designated as the most difficult air front of all, while it is reported that the Allies definitely have the upper hand in the Pacific air war. The introduction of new aircraft types by the enemy is noted. Relative to the home front, comment is made upon the Army's publication of new Field Service Regulations FM 100-20 on the command and employment of air power. *Skyways*, January, 1944, pages 30, 31, 86, 88, 7 illus.

Air Power Still Lacking in War Against Japan. Tom Ashley. A commentary upon the inadequacy of United Nations' land-based air strength in the Pacific combat areas. While reporting that the Navy has plenty of carrier-based units fighting against Japan, the writer indicates the need for long-range bombers on the part of the Eleventh Air Force in the Aleutians, the Seventh Air Force in the Territory of Hawaii, the Thirteenth Air Force in the Solomons, the Fourteenth Air Force in China, the Tenth Air Force in India (which is evaluated as the strongest of the United States air groups in the Pacific), and the Fifth Air Force in New Guinea. For victory over Japan, it is his opinion that bombers of the B-29 type are needed. The writer also makes several observations with regard to the future trend of the air war in the Pacific, reminds his readers that Japanese industries are not confined to her own island but are spread out over Manchukuo also, and briefly reviews the general record of air campaigns in the Southwest Pacific. *Southern Flight*, December, 1943, pages 29–31, 35, 5 illus.

Air Transport

Architecture and Air Transportation. Francis R. Meisch. Basic information is given on the background of aviation progress and the architectural and city-planning developments that are affected by the growth of air transportation. The article is divided into two sections. Part 1 discusses the status of aviation design, consideration being given to types of aircraft and the pattern of development. How the cost and size of the airport may affect increase in the size of aircraft is discussed. It is stated that there is a potential demand for a commercial aviation system of much greater size than any existing system. The realization of such a system will be based on a better understanding of the relation of space and time, a restudy of physical geography, a reanalysis of commercial geography, and a further study of the capabilities of the airplane.

Part 2 discusses aviation as a stimulus to architecture. The basic requirements for ground facilities are considered under sections dealing with airports, terminal buildings, facilities for passengers, the separation of mail and passenger traffic, the efficient operation of air terminals, weather protection at the terminals, problems in handling air cargo, and independent power plants for municipal airports. *New Pencil Points*, November, 1943, pages 36–63, 69 illus.

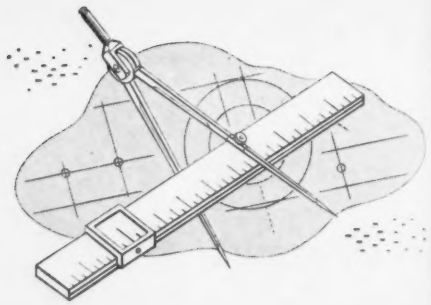
USSR Airlines—Better Than You Think. Joseph H. Riseley. As a guide for negotiations to come in the postwar era, the writer made an investigation of air transport in the Union of Soviet Socialist Republics. The article presents the results of this study. The development of the nation's air transport system is traced, and statistics are given on mileages, passengers, freight, population density, competing transportation facilities, and other data. *Air Transport*, December, 1943, pages 29–33, 7 illus.

CPA Serves Yukon. Ronald Keith. This article deals with the transport services operated by Canadian Pacific Airlines, Ltd., in the Yukon territory . . . . along the Mackenzie River, from Edmonton to Whitehorse, Yellowknife, Fort St. John, Vancouver, and other points. After introductory details on the history of the routes operated by Yukon Southern, Mackenzie Air Service, and Canadian Airways, the merger of the three northern flying companies under Canadian Pacific Airlines, Ltd., is related and present-day operations are surveyed. The information includes data relative to routes, fares, equipment, traffic statistics, air personnel, weather services, pilot instruction, maintenance of aircraft, stores of equipment, qualifications of stewardesses, executive personnel at western headquarters, and captains flying the northwestern routes for C.P.A. *Canadian Aviation*, December, 1943, pages 94, 96, 98, 100, 7 illus.; "On Top of the World," *Commercial Aviation*, October, 1943, pages 38–42, 17 illus.

Cruise Control for Flying Efficiency. Dixon Speas, Jere T. Farah, and Sanford Hinton. This fifth article in a series on cruise control deals with methods of determining flight time and fuel requirements under varying weather conditions. In outlining the computations for establishing the amount of fuel and the time required for any given flight, the following phases are considered: (1) Taxi, run-up, and take-off; (2) climb; (3) cruise; (4) descent; and (5) reserve. The article is illustrated by zone fuel consumption and effective wind charts, a chart giving the effect of wind on fuel consumption, and a table showing fuel and time allowances for climb with a typical DC-3 airplane. *Aviation*, December, 1943, pages 215–217, 324, 327, 3 illus.

Merging of Air and Water Transportation Is Called a Logical Development. Henry F. Grady. Commercial aviation in the postwar period is discussed in the expectation that there will be substantial expansion in all phases of aviation. It is stated that the steamship industry is not seeking protection from air-line competition but is merely asking the right to meet that competition on an even basis and be allowed the use of air transport to develop and advance further its own service in accordance with demands. Other subjects discussed include postwar subsidies, reduced flying fares, mergers in Britain, and the place for steamships. *Air Transportation*, December, 1943, pages 28–33, 1 illus.

United Air Lines' Safety Program. Jack Curtis. United Air Lines' methods for reducing accidents among its ground personnel are outlined. Major factors in the company's safety program are the employment of full-time safety experts, organized employee participation, an employee suggestion system, and department cooperation. "Light reflection" painting of machinery is exemplified as one of the procedures



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instituted. *Flying*, January, 1944, pages 26–28 (Air Commerce Section), 3 illus.

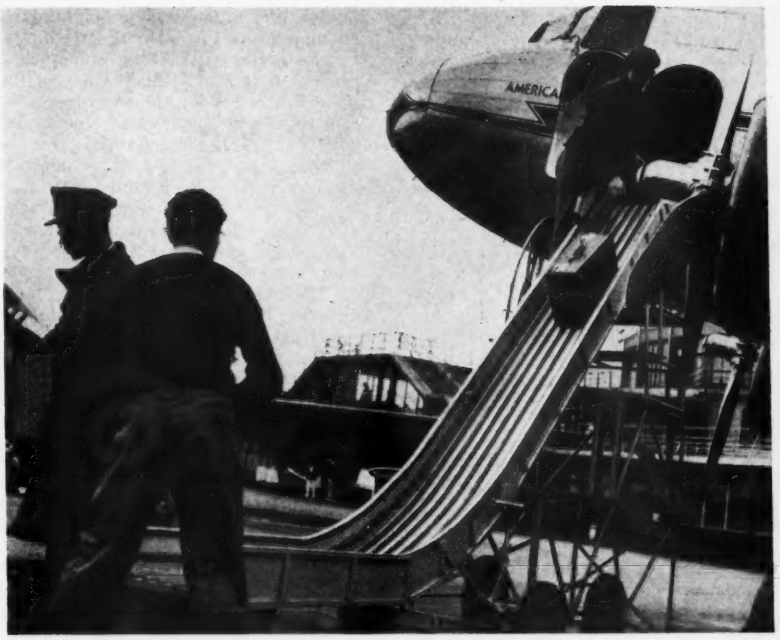
The Americas. Josh Lee. The conclusion of an article surveying air transport in the Americas. The growth of air transport in Latin America is described and the outlook for its future expansion is discussed. Passenger, cargo, and air-mail facilities are considered. The future of trade and travel in South America also is discussed. *Airlanes*, December, 1943, pages 6, 16.

Guerilla Airline. This history of China National Aviation Corporation depicts the struggles of this air line to maintain civil air operations through years of attack by the Japanese. It relates how, bombed and strafed out of one Chinese city after another, C.N.A.C. continued its operations and set up new routes and bases from other points in China. Describing the vital services that the air line performed for the Chinese, the article includes notes on the organization of the company, some of the problems it faces in a war-torn country, its equipment, and the heroism of its personnel. Several of its various pilots are named. *Southern Flight*, December, 1943, pages 32, 33, 52, 54, 64, 12 illus.

Canada's Great Aerial Main Line. A series of notes relative to the western activities of Trans-Canada Air Lines and supplementing a more detailed article that appeared in a previous issue of the magazine. This account features the maintenance and overhaul operations conducted at the Winnipeg plant. It is also concerned with the number of personnel employed by the company, the proportion of men and women, the draft status of employees, and the joint cooperative committee of management and employee representatives. *Commercial Aviation*, October, 1943, pages, 64, 66, 8 illus.

Aircraft Supply to the Middle East. Air Commodore J. L. Vachell. The establishment in 1940 of a route by which short-range aircraft from Britain and the United States were supplied to the Middle East is recorded. Starting at Takoradi on the West Coast of Africa, where crated airplanes were assembled for flight, the aircraft were flown to Khartum. From there the route lay up the Nile to Cairo. Problems of assembly, living conditions, and flight are noted. Reference is also made to the route via Gibraltar and Malta by which the Middle East was supplied with long-range aircraft. *The Aeroplane*, November 12, 1943, pages 560, 561, 3 illus.

The Cruise of the "Galloping Gremlin." John Yoxall. The third of three articles on air operations in the Mediterranean area recounts the writer's journey through the territory from which his observations were culled. It follows the flight of 7,466 miles—made in Dakotas of the British Air Transport Command and of British Overseas Airways—from Britain through Lisbon, Algiers, Tunis, Syracuse, Taranto, Salerno, Malta, Gibraltar, etc., and back to Britain. . . . giving a picture of international air travels in wartime. *Flight*, November 4, 1943, pages 505–510, 10 illus.



A functional piece of new equipment for American Airlines, Inc., is this wooden cargo slide devised to simplify unloading problems. The unit fits snugly to the top of the standard loading platform. A trial period has proved the slide practical, and the air line expects to install similar equipment at many stations throughout its transcontinental system.

Airway Traffic Control in Canada. Ewan D. Boyd. A continuation of a series of articles on flying the airways of Canada. Part VI consists of a digest of present Airway Traffic Control procedures and is intended for the benefit of pilots whose duties require them to fly on or across the Federal Airway routes. Rules for flight by instrument are covered, as well as rules for flight by contact. Advice is given for planning both types of flights. *Commercial Aviation*, October, 1943, pages 90, 92, 94, 6 illus.

Airline Economic Planning. John Stuart. Some observations on civil air transport planning, interpreted from testimony submitted at the C.A.B. hearings. The writer touches upon: the ownership of air transport facilities by surface carriers; hearings relative to the plans of major air lines, small carriers, and prospective carriers for "200-mile" routes; modifications of conventional aircraft for local and feeder service; direct operating costs; airport planning; and international aviation. *Flying*, January, 1944, pages 22–24, 30 (Air Commerce Section), 4 illus.

Airplane Descriptions

Mosquito Versatility. Stressing the fact that speed is the paramount factor in any type of military aircraft, the versatility of the de Havilland Mosquito is indicated by an outline of 15 varying functions it fulfills. Among the applications featured are the use of the Mosquito as a night fighter, photographic reconnaissance plane, and a transport model. *Flight*, November 11, 1943, pages 524, 525, 5 illus.

Comparison of Structural Details of Leading German Aircraft. Part II of an examination of seven German aircraft: the Heinkel He 111; Junkers Ju 87 and 88; Dornier Do 217; Messerschmitt Me 109, 110, and 210; and Focke-Wulf FW 190. This installment is concerned with the flaps, control circuits, engine mountings for both liquid-cooled and radial engines, and undercarriages of these aircraft. It calls specific attention to the undercarriage details as they appear in the FW 190, Do 217, Ju 88, and Me 210. In addition to miscellaneous design features such as castings and welded components, the use of plastics, and extrusions, it also investigates the connection of subassemblies, engine installations, and inspection covers. Several tables supplement the article. One gives details of fuselage stringers; another covers details of fuselage frames; others include weight summaries of the FW 190A-e, Me 109F-1-2, and Do 217-1. *Commercial Aviation*, November, 1943, pages 90, 92, 94, 96, 98, 100, 7 illus.

Transports and Trainers. A compendium of the main types of United States transport and training airplanes. Each plane is illustrated by a photograph and characterized by some brief descriptive data. *Skyways*, January, 1944, pages 40, 41, 1 illus.

L'Avion de Combat Allemand "Junkers" Ju-88-A6 (The German Bomber "Junkers" Ju-88-A6). Ac-

cording to this report the Ju 88-A6 is one of the Luftwaffe's best bombers. It is a twin-engined, cantilever low-wing, all-metal monoplane. The diving brakes are installed under the wings outside the engine nacelles. This bomber has two Junkers Jumo-211, twelve-cylinder, in-line, air-cooled engines which develop 1,200 hp. at take-off. The circular cowlings give the appearance of radial engines.

The defensive armament consists of one mobile machine gun in the nose of the cabin, two mobile machine guns at the firing posts in the rear of the cabin, and one mobile machine gun in a nacelle below the fuselage. When the airplane is used as a night fighter, the armament is increased by three fixed 7.9-mm. machine guns and at least two 20-mm. cannons firing forward, as well as other arms provided for defense in case of retreat which are installed in posts in the rear or below the fuselage. In additon to four bombs of 250 kg. each for dive bombing, the Ju 88-A6 may carry a maximum bomb load of 500 kg. for bombing in horizontal flight.

Performance is given as follows: As a dive bomber, maximum speed is 400 km.p.h. at 5,000 m. and service ceiling is 6,400 m. When used as a night fighter, maximum speed is 465 km.p.h., cruising speed at 5,500 m. is 386 km.p.h., practical ceiling is 7,300 m., and cruising range is better than 2,000 km. In the night fighter version the bomb racks are replaced by supplementary fuel tanks. This airplane has a span of 19.8 m., a carrying surface of 54 sq.m., and its total flying weight is 11 tons. It carries 2,950 liters of fuel in five tanks—four of 425 liters each in the wings and one of 1,250 liters in the fuselage. The supplementary tanks have a total capacity of 700 liters. *Schweizer Aero-Revue*, October, 1943, pages 388, 389, 3 illus.

Flying Refrigerator Cars Mapped by Colonial Airlines on 8-Cent Ton-Mile Basis. Information is given on a 120-ton flying wing, refrigerated fruit-express plane with a pay-load capacity of 40 tons which is being developed for postwar use to reduce hauling costs. The lateral loading of cargo into the wing will be a feature of the design. It is stated the plane will be powered with four 5,300-hp. duplex gasoline or Diesel-type engines. Figures are given on the hauling time between various cities. Other advantages of the development are outlined. *Air Transportation*, December, 1943, pages 17, 18, 2 illus.

Airports

Airways of the Future. A brief description is given of an air-traffic control system suggested by Richard Lonsdale-Hands as a possibility by 1968. The system is offered as a means of meeting the problem of controlling high traffic densities. Electronics would be the foundation of the system which would embody a three-dimensional beam grid encompassing the earth. The aircraft would move along the beams under a system of regulation resembling the familiar block system of railroads but with the difference that air provides room for an ascending series of travel lanes giving successively fewer intersections. *Modern Transport*, November 13, 1943, pages 5, 6, 1 illus.

Gatwick Airport. Four possible schemes are proposed for the development of Gatwick Airport near London. One is a "small or local" scheme, entailing no disturbances of the nearby road, river, and racecourse or of existing airport buildings. The "continental scheme" involves diverting the road, removing the racecourse and existing buildings, and culverting or diverting parts of the river. Plan number three, called the "Trans-Atlantic scheme" necessitates diversion of the road and features a main runway of from 4,000 to 6,000 yards. The fourth plan is a partial development of the "continental scheme," taking in the greater part of the existing racecourse. *Flight*, November 25, 1943, pages 578–580, 5 illus.; "World Air Junction," *Aeronautics*, December, 1943, pages 40–44, 7 illus.

Driving the Driven Snow. George Herrick. A survey of snow-removal methods and equipment now being used by airports. The article describes snow-handling equipment and recommended practices. The use of plows, the advantages of the rotary plow, and some of the objections to its use are among the subjects discussed. Consideration is given to the operation of plows in echelon, V, and close formations and to such methods as compaction, the combined rolling and plowing of snow, chemical melting, etc. *Air Transport*, December, 1943, pages 34–39, 12 illus.; "Winning the Battle with Snow," by Hal. W. Hunt, *Scientific American*, January, 1944, pages 19–21, 5 illus.; "Snow and Ice on Airport Pavements," *Aviation Maintenance*, January, 1944, pages 64, 65, 140, 142, 7 illus.

Automatic Communication for Air Traffic Control. Maurice Roddy. As planned by the C.A.A., a system for automatic communication and posting of flight data is described. Essentially this mechanical system would consist of a network of printing telegraph circuits connecting airway traffic control centers to each other, to airport control towers, and to other points, along with automatic means for transmitting, receiving, decoding, recording, and posting flight information on flight-progress boards, airport control-tower boards, and auxiliary posting boards. A tentative schedule for extension of an automatic communicating and posting system to various airway traffic control areas is presented. This indicates the fiscal year proposed for installation of the automatic systems in the vicinity of 23 important cities in the United States ranging from 1945 to 1953. The article also contains a comparative tabulation of the major features in the handling of flight data under present manual methods and proposed automatic methods.

To obtain full advantage of the adaptation of electrical methods to the operation of flight-progress boards, three objectives are counseled: (1) the integration of communication and posting facilities to keep the tabulations of flight data up to date and avoid the control room congestion caused by the assistant controllers required for manual posting; (2) the improvement of tabulations to make more data readable by several controllers in order that they can secure coordination when traffic in a sector has to be divided; (3) the greatest possible reduction in the amount of work per flight required of controllers and of assistant controllers in order that more flights may be handled by each man, thus holding the number of control room personnel to a minimum. *Flying*, January, 1944, pages 13–15, 29 (Air Commerce Section), 1 illus.

City Skyports. L. Horace Silberkleit. Developments directed toward the planning and construction of municipal airports for postwar aviation are discussed. Information is given on New York City's Idlewild airport and the Boston skyport. *Aircraft Age*, February, 1944, pages 26, 56, 57, 2 illus.

Canada's Largest Pacific Airport. Wilfred P. Braggins. A detailed article on the building of Canada's largest Pacific airport. Performed by the King Paving Company, Ltd., of Oakville, Ontario, the job is reported to typify the conditions encountered and methods adopted by the Dominion Department of Transport in constructing a number of airports in British Columbia and the Yukon during the past 12 months. It represented a problem of laying and paving 400,000 square yards of area during severe winter conditions.

Beginning with the awarding of the contract and the clearing of the site, the article traces the building procedures through the grading, crushing and screening, fine-grading, paving, and inspection operations. Other factors relative to the airport with which it is concerned are drainage, lighting system, water and sewage, roadways, snow removal, seeding, and personnel. *Commercial Aviation*, October, 1943, pages, 107, 108, 110, 9 illus.

Airports and Air Traffic Control. Glen A. Gilbert. Second part of a discussion showing the important relationship between efficient airport designs and air-traffic control. This installment covers the factors to be considered in designing the taxiway system and outlines the ten airport design requirements of air-traffic control. In the light of the basic requirements outlined, it then examines a few

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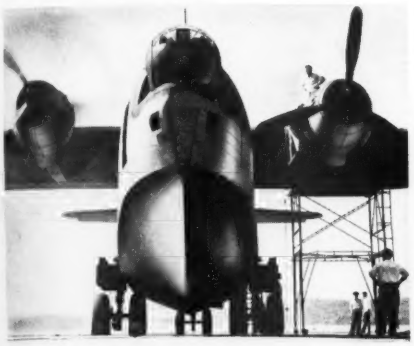

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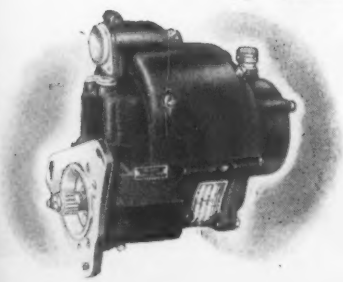

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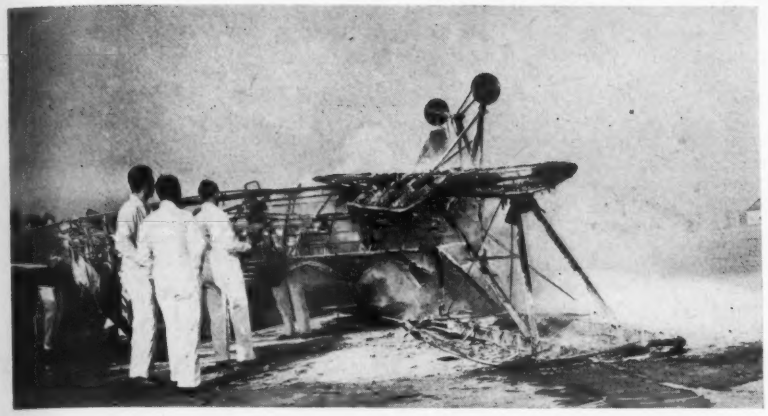


To test the efficiency of a newly developed fire extinguisher that discharges fine powder forced through a nozzle by carbon dioxide, a crew of Pan American Airways' hangar fire fighters extinguished the fire on a burning biplane in 2 min., 10 sec.

typical airport designs in use today and points out their deficiencies. In conclusion, three general fundamental designs are indicated for future use. These are: (1) a rectangular airport having loading facilities on one side of the airport; (2) a rectangular airport with loading facilities on one side, but extending in a V shape toward the center of the airport; (3) a central-design airport having the loading facilities in the center of the airport with runways at a tangent to the center. *Flying*, January, 1944, pages 19–21, 30 (Air Commerce Section), 9 illus.

Vancouver Builds an Airport. Aubrey F. Roberts. The development and construction of Vancouver Airport are described. Combining facilities for both airplanes and flying boats, the airport was municipally owned but was taken over by the Canadian government in 1940 for the duration of the war. In addition to particulars on the box and "mole" system of drainage employed, notes are included on other design features, appropriations, improvements instituted by the government, and companies leasing buildings, and operating services from the airport.

William Templeton is credited with having played a prominent part in the construction and management of the combined air harbor. *Commercial Aviation*, October, 1943, pages 80, 82, 84, 7 illus.

Acres of Air Strength. Capt. Dick Martin. A description of the Oklahoma City Air Depot and Tinker Field, hub of the Oklahoma City Air Service Command. Information is given relative to the physical characteristics of the Depot, the structures and runways which it encompasses, the activities conducted there, and the history of the base. *Airlanes*, November, 1943, pages 7, 28, 4 illus.

Approach Control. Gerald D. Crowley. A report on a new method of traffic control over aircraft landing during instrument weather conditions soon to be installed at a number of major airports. Known as approach control, the system is based upon the delegation of jurisidiction over arriving and departing aircraft to airport traffic-control towers instead of to airway traffic-controls centers. During instrument, as well as "ceiling unlimited," weather conditions, the traffic controller in the tower is in direct radio communication with all pilots through the voice facility of the radio range station adjacent to the field. It is reported that the time thus saved in the issuance and acknowledgment of instructions will amount to several minutes for each approach conducted. A description of the approach control system as proposed for operation at Salt Lake City serves to illustrate the general workings of the procedure. *Flying*, January, 1944, pages 43, 98, 2 illus.

Will Rogers Field. Capt. John Hamil. A series of notes on Will Rogers Field, U.S. Army Air Forces training field and Air Base Area Command. The field's history is briefly outlined from its dedication in June, 1941, to the present. Increases in personnel and facilities, enlargement of the scope of activities conducted at Will Rogers, and changes in command are marked. *Airlanes*, November, 1943, pages 18, 32, 1 illus.

Armament

Nazi Secret Weapons Exposed. Robert Emmett Frazier. Some information and comments are given on secret weapons developed by the Germans, and on what may be accomplished with them. This consists largely of speculation about rocket-propelled gliders, jet-propulsion aircraft, so-called "flying torpedoes," remotely controlled aircraft, and other possible or rumored weapons. It is stated that many of these "fantastic" ideas are not mysteries to our scientists and military men and that means of defense against them are being developed. Differences between rocket weapons and guns are explained. *Aircraft Age*, February, 1944, pages 14, 15, 50, 52, 2 illus.

Die Visiere fuer die Flugzeugbekaempfung (Sights for Antiaircraft Guns). I.—General Principles. A. Kuhlenkamp. In the first of a series of articles about the sights and firing methods of antiaircraft guns it is asserted that the accuracy of fire of antiaircraft guns on the ground or aboard airplanes depends largely on the flawless operation of the sights. The principal problems of sights are, first, to represent the line of sighting by means of sighting devices (sight notch, bead, reflex sight, telescopic sight) and, second, to calculate the amount of lead. The writer describes the methods of representing the sighting line and of making the calculations for lead as employed on modern sighting devices in Germany and in other countries. He also calls attention to the construction of foundations for guns to fit the shape of the gun carriage in order to facilitate sighting within the entire angular range. *Zeitschrift des Vereines Deutscher Ingenieure*, September 18, 1943, pages 577–585, 28 illus.

Reflector Gun Sights. Based upon notes and illustrations released by the Ministry of Aircraft Production, two typical models of reflector gun sights are described—one for movable and the other for fixed guns. As given, the Free Gun Reflector Sight, Mark IIIA, consists of a diffused monochromatic light source that illuminates a graticule consisting of a translucent ring and bead pattern etched upon an opaque ground, a lens system forming an image of the graticule pattern at infinity (500 yards). A transparent reflector, inclined at 45° to the optical axis and through which the target is viewed, reflects the luminous graticule image that appears superimposed upon the target. A dimming screen, consisting of a neutral-tinted optical flat for enhancing contrast between the luminous image and bright skies and a hood, complete the basic components of the sight.

The Pilot's Reflector Gun Sight, Mark II, is used for fixed gun installations and is therefore rigidly attached to the aircraft, usually behind the windshield and in the pilot's line of sight. Major differences noted from the Mark IIIA are the incorporation of a range estimator and the elimination of the hood. *Flight*, November 25, 1943, pages 590–591, 5 illus.

Business and Finance

Financing Britain's Air War. Walter Hill. An outline of the "shadow factories" and "fixed cost" schemes under which wartime expansion and operation of Britain's aircraft industry were conducted. Under the former plan large numbers of factories for building aircraft and aircraft components were constructed before the war by the government at its own expense and managed, for a fee, by the automobile, engineering, and associated industries. When war came, these industries—experienced in the manufacture of airplanes through the management of government factories—added

their own facilities to those of the airplane manufacturers. As it exists today the British aircraft industry is reported to consist of a number of groups, each specializing in the production of one type of plane and each headed by one of the old-established designing firms. . . . with a number of automobile, engineering, and other firms as subcontractors.

The "fixed price" is the financial basis for the system of contracts between the Ministry of Aircraft Production and the main contractors. In nearly all cases prices are based on technical estimates rather than on post-costing and are aimed at providing no more than a reasonable return on the capital employed. As costs vary from firm to firm, they are determined for each contract by negotiation between the M.A.P. and individual contractors.

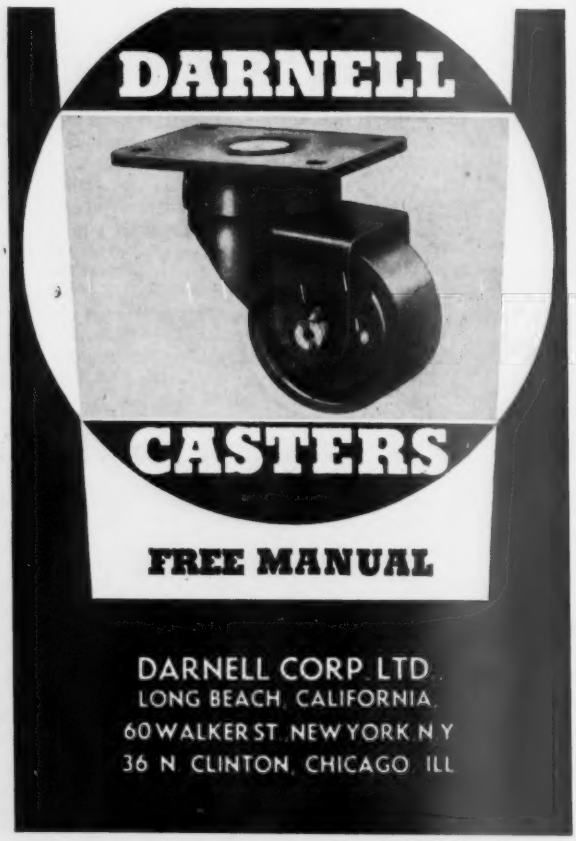
The trend of the profits of some major British companies is revealed in accompanying tables. They show, since 1935, the amount earned on the ordinary capital after deduction of income tax, the dividend paid as a percentage of the ordinary capital, and the amount of the ordinary capital issued in the cases of Rolls-Royce, Ltd., Hawker Siddely Aircraft Company, Ltd., and Bristol Aeroplane Company, Ltd. *Western Flying*, December, 1943, pages 60, 90.

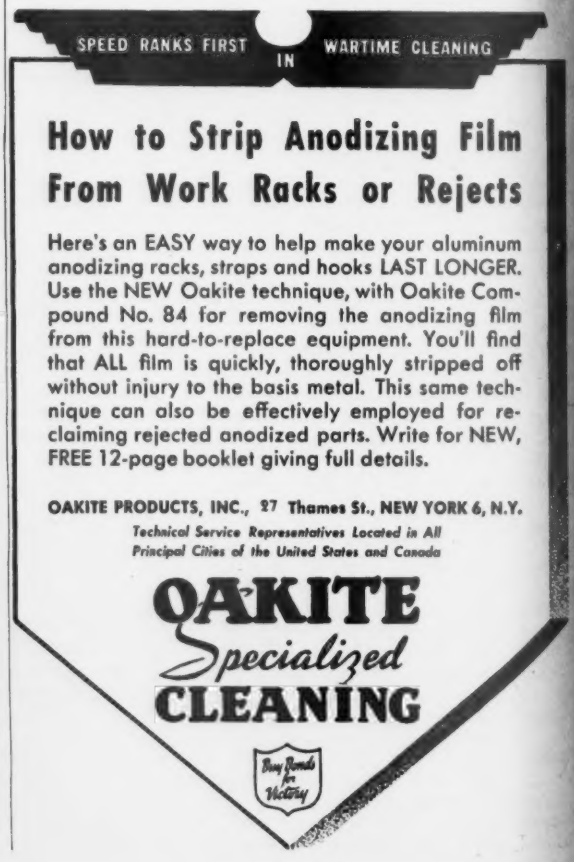
Conflicting Reports Confuse Aviation Investors. H. L. Federman. A discussion of market trends of aircraft equities. Reporting that peace consciousness on the part of the public has not only caused heavy selling of airplane manufacturing shares but also con siderable liquidation of airline shares—supposedly a "peace" group—the writer offers an explanation of this condition. He points out that, while airplane manufacturing securities have not been particularly favored throughout the war years, air-line stocks have shown increasing evidence of outdistancing their future prospects . . . . with the result that the public is only now taking into consideration some of the problems with which the air-line companies will have to contend in the post-war world. Naming specific stocks and investment companies, he reviews the attitude of investment trusts toward both types of aircraft equities as revealed by recent buying and selling. Three tables supplement the market analysis: One shows the combined aviation holdings of 30 major investment trusts as of September 30, 1943; another lists the aviation portfolio changes of the National Aviation Corporation from December 31, 1942, to September 30, 1943; and the third gives Barron's Stock Averages from October 7 through November 4, 1943, compared with those for November 6, 1942. *Aviation*, December, 1943, pages 197, 335, 336, 339.

Planning for Post-War Aviation Insurance. Edgar T. Allen. Specifying the necessity for reducing the cost of aviation insurance, the writer suggests some ways in which methods of computing rates could be improved. He advocates the application of the "experience rating" principle in the aircraft insurance field, whereby the rates are lower for the man who has never had an accident than for the man who has them chronically. Lower rates for the insurance of whole fleets of planes, as compared with the insurance of just one plane, are also considered justified. The fallacy in the belief of operators who think they always have to "break even" on their insurance is pointed out. *Western Flying*, December, 1943, page 90.

Camouflage

Aviation Masquerade. Clarence G. Beardslee. The work of the Aviation Engineers section of the Army's Corps of Engineers is described in an article that shows how the men are trained at the Engineer Aviation Unit Center at March Field and how their skill is applied. Aviation engineers provide protective concealment for all units of the Army Air Forces by blending art, nature, engineering, shrewd psychology, and imagination in the achievement of successful deception. Numerous tricks of camouflage are explained. *Air News*, November, 1943, pages 30, 31, 56, 7 illus.

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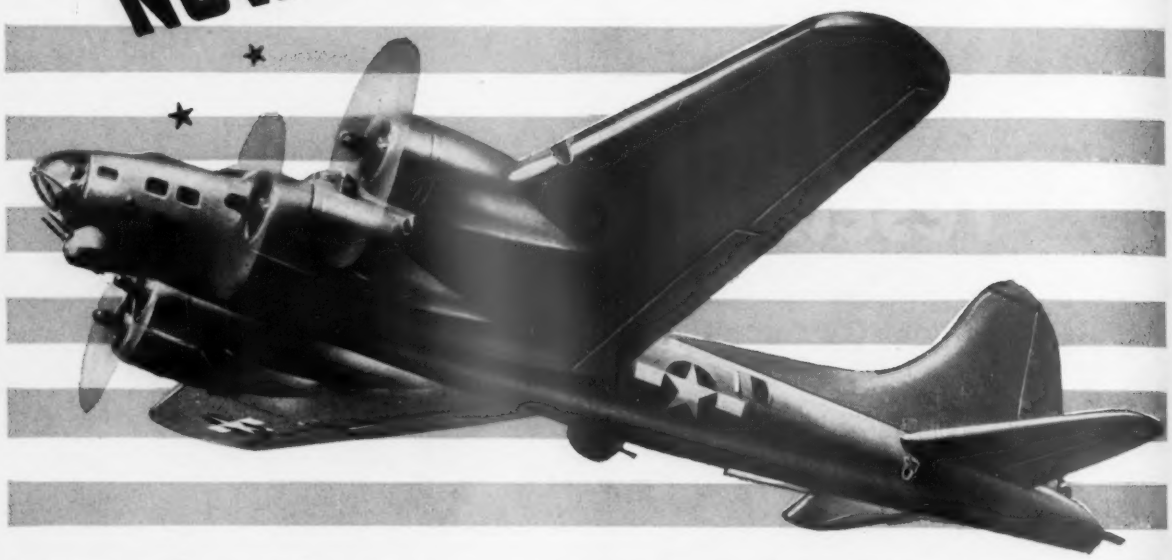

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Civil Aviation

Don't Sell the Fixed Base Operator Short. As an example of how fixed-base operators can successfully continue to function without Government contracts, the operations and policies of General Airmotive Corporation are described. The methods of the company with regard to conducting the following activities are noted: its work as sales agent for different manufacturers of aircraft components; the overhaul of aircraft, engines, propellers, and accessories; and student training, in ground work as well as flying. *Aviation*, December, 1943, pages 226, 227, 299, 300, 303, 5 illus.

Civil Aircrews and Post-war Flying. A declaration of policy is issued jointly by the representatives of the Guild of Air Pilots and the British Air Line Pilots' Association. The planned course of action for the activities of the two organizations with regard to the well-being, status, and professional skill of present and future civil flying personnel is outlined. *Flight*, November 18, 1943, page 555.

Indian Civil Aviation. A Bombay Correspondent. A brief outline of the development of civil aviation in India. The writer discusses early development, later advances, and government assistance. *Aeronautics*, December, 1943, page 52.

Farmers with Wings. P. Puckett. The application of aviation to agriculture is discussed in an article describing how the use of airplanes is aiding the farmer. Subjects discussed are the use of the airplane for spraying crops, planning the national acreage, and sowing seeds. *Aircraft Age*, February, 1944, pages 18, 19, 54, 5 illus.

Companies

Victory Aircraft Limited Steps Up Production. Some notes on the development and current production of Victory Aircraft Ltd. A chronologic outline of the company's history from 1937 to 1943 is featured. Differences between the English version of the Avro Lancaster and that produced by Victory Aircraft are marked, and comments are included on the personnel, facilities, and future plans of the company. *Canadian Aviation*, December, 1943, pages 72–74, 5 illus.

Federal Aircraft Limited on Anson V Program. A brief review of the activities of Federal Aircraft Ltd. during the past year. Attention is centered around the fact that the year marked a transitional period during which the company changed from production of the Anson Mark II to that of the Anson Mark V—involving the use of a different type engine, new power brakes, and a molded veneer fuselage instead of the usual fabric and wood-faired tubular structure. The acquisition of new facilities, the production of a prototype Mark VI, the functioning of Federal Aircraft as a principal purchasing agent for various materials and parts, and its work in connection with supplying of spares are also recounted. A list of the company's executive officers concludes the article. *Canadian Aviation*, December, 1943, pages 75, 100, 5 illus.

MacDonald Bros. Limited Doubles Staff in Year. The work of MacDonald Bros. Aircraft Ltd. for the year of 1943 is summarized. Related activities include the manufacture of spares and parts for the Anson Mark I, II, and V; the Airspeed Oxford; the Hawker Hurricane; the Curtiss Helldiver; the PBY Catalina; the Noorduyn Norseman; and aircraft overhaul on Anson planes. Increases in floor space are reported as well as the fact that the number of persons has doubled. *Canadian Aviation*, December, 1943, page 90, 3 illus.; "Building Aircraft for Air Training," *Commercial Aviation*, October, 1943, pages 56, 58, 6 illus.

Noorduyn Largest Producer of Aircraft in Canada. Increases in efficiency and production, additional facilities, improved equipment and manufacturing methods, and accomplishments in the field of labor relations are reported in an outline of the progress made by Noorduyn Aviation Ltd. during the year of 1943. In addition to being described as the largest producer of aircraft in Canada, Noorduyn is credited with having the only factory in Canada building more than one type of complete aircraft and being the only company in Canada producing aircraft of its own design. The names of the company's executives are listed. *Canadian Aviation*, December, 1943, pages 106, 108, 5 illus.

Canadian Vickers Ltd. on Gigantic "Canso" Program. Activities of Canadian Vickers Ltd. are depicted by a description of the PBY Canso amphibian which the company is engaged in constructing. Details on the plans are submitted under headings of wing, hull, tail, surfaces, landing gear, and power plant. Executives of Canadian Vickers are named. *Canadian Aviation*, December, 1943, pages 110, 112, 7 illus.

Fleet—Cornell. Employee-management relations and the system of working with subcontractors are given prime importance in a brief account of Fleet Aircraft Ltd. production. *Canadian Aviation*, December, 1943, pages 114, 116, 136, 10 illus.

Canadian Car & Foundry. A summary of the Canadian Car & Foundry Company's activities for 1943 covers the operations of several plants and records the different aircraft components produced by each. The plants with which the article is concerned are those at Fort William, Point St. Charles, St. Laurent, Dorval, and Amherst; the Propeller Division; and Turcot Aircraft. In addition, the names of Canadian Car & Foundry executives are listed. *Canadian Aviation*, December, 1943, pages 118, 120, 6 illus.

Boeing of Canada Has Four Plants on "Canso's." The production program of Boeing of Canada is outlined. In addition to its major activity of manufacturing Consolidated Catalina amphibians, the fabrication of assemblies for other Canadian planes is reported. The article also stresses the bond between the Canadian division and the parent company in Seattle and briefly reviews the primary functions of the production, purchasing, tooling, flight operations, inspection, and personnel departments. With expansion of structural facilities noted, the several main plants and subsidiaries comprising Canadian Boeing's factory setup are mentioned. *Canadian Aviation*, December, 1943, pages 130, 132, 5 illus.; "Boeing's Proud Production Record on P.B.Y.'s," *Commercial Aviation*, October, 1943, pages 43, 44, 46, 12 illus.

Fairchild Now Turning Out Curtiss Hell-diver. In a review of the development of Fairchild Aircraft Ltd. since 1938 some of their methods of meeting production, training, and tooling problems are described briefly. Given figures show that by 1943 Fairchild plant area had increased by more than 1,000 per cent, personnel by 590 per cent, and production by 2,000 per cent.

The fact that the company has added to its program of producing Bolingbroke orders for fabricating SB2C-1 Curtiss dive bombers is featured. A list of Fairchild executive personnel rounds out the article. *Canadian Aviation*, December, 1943, pages 134, 136, 4 illus.

De Havilland Producing "Canadian" Mosquito. A series of notes relative to the production of Mosquito fighters by de Havilland Aircraft Ltd. Comment is made upon the current changeover of the Toronto plant from a manufacturing center to an assembly point, as well as upon some recent additions to the floor area of the organization. Other discussion is pertinent to the company's training scheme, some production problems, plane modifications, features of the Mosquito, and the de Havilland testing field. *Canadian Aviation*, December, 1943, pages 139, 140, 7 illus.

Control Equipment

Flexible Cable Control Eliminates Backlash. Details are given on a flexible type of aircraft control, developed by means of Teleflex cable, in which slackness or creeping are reduced to a minimum. Consisting of several layers of wire wound around a core and an outside layer of comparatively large diameter wire wound in the form of an open helix, the cable oper-

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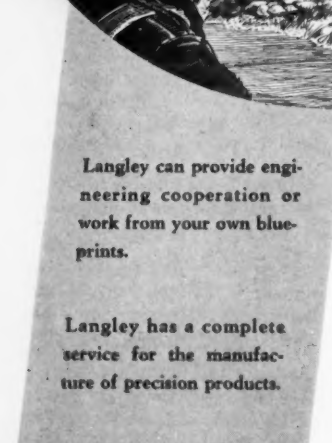
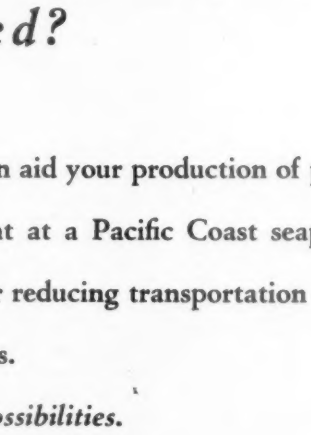


Establish a contact now which can grow into a readily available source of postwar precision production in the rich and growing Pacific Coast market.



LANGLEY CORPORATION

PRECISION Manufacturers

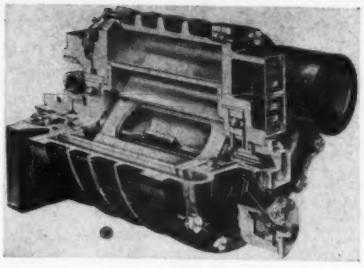
SAN DIEGO ★ CALIFORNIA

Langley produces PRECISION flight, float and landing control units used on heavy bomber, patrol and cargo planes, now in the thick of the fight.

ates in a dural x tube . . . . transmitting both push and pull. The helix wire is rounded to form a good bearing surface in contact with the tube, thereby reducing friction. It is claimed that this control is positive in action under all loads for which it is used and that it is sufficiently flexible to absorb all vibration and relative movement encountered in an aircraft. Testimony to the satisfactory performance of this control is offered by the fact that it is used on the propeller-pitch controls of R.A.F. aircraft such as the Mosquito, Lancaster, Typhoon, and Spitfire.

A description of the cable follows an examination of the primary factors in power-plant and propeller controls. The considerations discussed are positive action, backlash, flexibility, stress loads, simplicity, weight, efficiency, rigid rod controls, cable controls, and flexible mechanical controls. *Aviation*, December, 1943, pages 189, 191, 303, 304, 4 illus.

Manual Fuel Control Saves on Long Hauls. B. E. Cole. A description of a method of manual fuel control which is stated to give a "best economy" mixture. It is related that 15 airplane types with engines of 450 to 2,000 hp. were tested under controlled flight conditions for 3,000 hours. With fuel consumption known at all times, indicated savings were up to 20 per cent with manually operated lean fuel flow. This article tells how the pilot can do it. *Air Transport*, December, 1943, pages 44–48, 7 illus.



The Eclipse type 764-6 engine-driven vane-type air pump. (*See* page 189.)

Design

Continental Aircraft Design Scholarship Awards. The winners of the twelfth airplane-design competition among aeronautical students at the University of Detroit are announced. The designs winning first and second prizes are described at length. Each of these is a design for a light plane for civilian business or sporting use. The descriptions, specifications, and drawings were prepared by the individual prize winners. *Aero Digest*, December, 1943, pages 122, 123, 274, 276, 3 illus.

The World's Best Aircraft. Peter G. Masefield. The former technical editor of *The Aeroplane*, now personal advisor on civil aviation to Lord Beaverbrook, names his choice for the world's best airplane in each of 22 major military and civil categories. Prescribing an exact formula for assessing the qualities of the planes, he rates them on a basis of 100 per cent for the ideal in each classification. Photographs and a table summarize the complete list of selected aircraft and the percentage at which each is graded. *Flying*, January, 1944, pages 21–25, 116, 19 illus.

Victory Through Air Power. Frank Murphy. This is a proposal for the building of "air battleships" to seek out the enemy's air fighting force and destroy it. It is suggested that such aircraft could be evolved from current bombers by dispensing with the bomb load and utilizing the freed carrying capacity for increased fire power and armor. The employment of jet propulsion for the "air battleships" is advocated and the writer speculates about the feasibility and advantages of building a fleet of "air battleships" at this stage of the war. However, supplementary comments to the article point out several deficiencies of this type of aircraft which are not mentioned by the writer. *Flight*, November 11, 1943, pages 526, 527, 2 illus.

Lofting Problems of Streamline Bodies. Part 20. Charles M. Hartley and Roy A. Liming. The twentieth in a series of articles on lofting reviews the projective and analytic principles that govern the development of a coordinated set of basic curves in plan, profile, and body-plan views and discusses the fundamental principles governing the approach to the problem.

Three cases are cited to show the method of determining whether the curve is a hyperbola, a parabola, or an ellipse. As a corollary to these projection techniques, it is shown that the analytic description of a given conic can reveal directly the nature of the conic. Mathematical calculations are worked out with the aid of drawings to verify the conclusions. The coordinating techniques are then applied to the three views of a nacelle shoulder line. Instructions are set forth for correlating the body-view contours with the projections of the original curve on the profile and horizontal planes. It is stated that, although perfect correlation in the three views suggests the ideal shape, such theoretic considerations must be constantly reconciled with problems relating to structural clearances. However, the preliminary designer and the loftman have available a definite foundation upon which to base a continuously correlated system of basic curves. Experience has demonstrated conclusively that even in the case of a highly streamlined pursuit airplane, such an ideal condition in fairing can be successfully achieved. *Aero Digest*, December, 1943, pages 176, 177, 179, 274, 5 illus.

Wanted: More 'Proof Test' Engineering. E. J. Foley. In this article it is stated that the aircraft industry seems to have more designers than laboratory men. Reference is made to the often-expressed need of air lines for the injection of more "operating consideration" into equipment design. According to the writer, aircraft operation and maintenance have been frequently and discouragingly frustrated by a designer straining for that last ounce of weight-saving or that extra mile per hour of speed.

It is stated that the gradual transition of engineering accent from design theory to practical proof testing may ultimately bring about a balance between these two phases of aircraft manufacturing. *American Aviation*, December 15, 1943, pages 72, 74, 1 illus.

The Tandem Monoplane. T. R. Young. Supplemented by sketches and a photograph of the model, details are given on the Warren-Young design for a tandem monoplane that was patented in Britain in 1939. This aircraft incorporates the tandem principle in a triangular wing plan. Among the advantages claimed by the designers for the triangular form of tandem aircraft as compared with orthodox types of planes are the following: (1) greater wing area for equivalent span; (2) unique disposition of weight owing to position of center of gravity; (3) elimination of stall owing to restoring moment of rear planes; (4) unusual stability owing to sweepback of front planes and sweep-forward of rear planes; (5) directional controls incorporated in the "tip surfaces" of the planes, eliminating the customary control and permitting greater simplicity of piloting. Superiorities of the triangular wing over earlier tandem models are also noted. The design is recommended as being particularly suitable for an initial training plane, although it is stated that it could be adapted for certain military purposes. *Flight*, November 18, 1943, pages 564, 565, 2 illus.

Graphical Aids for Designer and Draftsman. Part I. Harold C. Martin. In the first section of a two-part article, it is stated that graphic solutions of structural problems have, in general, two outstanding merits: (1) they are rapid and (2) they give a visual idea of the various factors affecting the solution. Several common design problems are examined with a view toward their simplification. Design charts are developed for the solution of the equations involved, and illustrative examples for each case indicate how simply the problems can be solved by means of the charts. Calculations are carried out and illustrative examples are given in the current installment for determining the margin of safety involved in the shear strength of a bolt and for welded joints. The de-

PEELING A PROSPECTIVE PLANE SKIN. Will this aluminum sheet be shipped as such or, will the plane manufacturer who ordered it save valuable man-hours by having it prefabricated into a complete plane part by skilled Reynolds workmen?

NO LOST TIME when you use Reynolds Prefabricated Plane Parts. Completely finished parts can go right on the assembly line as soon as they are received at your plant. This modern method, pioneered by Reynolds, saves you manpower, plant space, time and scrap.

. . . when you use REYNOLDS complete prefabricated Plane Parts Service

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- *SAVES SPACE*
- *SAVES TRANSPORTATION*
- *SAVES SCRAP*

From our global battlefronts come the never-ending pleas, "Give us more planes, better planes". . ."deliver them faster." In the face of this, fabricating aluminum sheets into plane parts in your own plant takes manpower you can ill afford to spare.

By using Reynolds prefabricated plane parts service you can use all of your manpower to build planes.

- It saves you manpower because every aluminum piece you receive is a finished part, ready for immediate assembly.
- It saves plant space because you do not have to maintain excessive stock piles, do all your own fabricating or store and segregate your own scrap.
- It saves on transportation because it releases freight cars needed to haul scrap metal from your plant.
- And it saves on scrap because the 30% of every aluminum sheet that becomes scrap is refabricated in our plants in a matter of hours instead of months.

Reynolds finished parts saving thousands of man-hours

Airplane labor amounting to thousands of hours is being saved by Reynolds prefabricated plane parts. In fact, Reynolds, the first aluminum manufacturer to furnish complete plane parts from aluminum sheet, is supplying complete parts to every leading manufacturer of combat planes.

It is this trait of daring to lead, daring to be different, that has spurred on Reynolds, in 4 short years, to where its operations now cover 40 plants in 14 states, plus its own source of Bauxite from which aluminum is made. This urge to constantly move ahead is what keeps Reynolds men on a ceaseless search for new ways to make aluminum better . . . make it easier and cheaper to use.

Take advantage of Reynolds' resources, equipment and engineering skill. For any problem you may have in working with aluminum, no matter what it may be, you'll find Reynolds able to handle it in the most practical way. Reynolds Metals Company, Aluminum and Parts Divisions, Louisville, Kentucky.

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REYNOLDS *The Great New Source of* **ALUMINUM**

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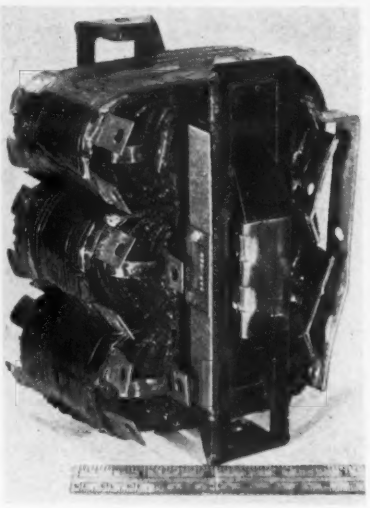
sign for an end fitting also is explained. *Aero Digest*, December, 1943, pages 219, 221, 223, 272, 274, 11 illus.

The Case for the Flying Boat. Taken from a report prepared by Saunders-Roe, Ltd., this article stresses the importance of marine aircraft to the British Empire and shows why the flying boat should not be neglected in the program contemplated by the British government for the development of postwar commercial aircraft. Advantages of the flying boat are summarized and its development from 1934 is briefly traced through a listing of the American and British civil and military models manufactured. In describing the advantages of the flying boat, the following design factors are discussed: hull size, drag, wing loading, and hull pressurizing.

The latter part of the article is devoted to recommendations with regard to the types of flying boats to be developed. Suggested types fall into three broad classifications: those for extreme-stage services, those for long-stage services, and those for medium-stage services. Some information is included on suggested methods for docking flying boats. *Flight*, November 25, 1943, pages 582–585, 595, 8 illus.

World's Best Planes. Peter Masefield, Hanson Baldwin, and Col. N. F. Silsbee. Naming their choices for the best planes in each of several categories, the three writers explain the reasons for their selections. The types are divided into bombers, light bombers, fighters, military transports, and naval aircraft . . . . with subclassifications under each main heading. *Skyways*, January, 1944, pages 38, 39, 91, 3 illus.

Designing for Production. Part VII (continued). James E. Thompson. A continuation of the seventh part of a series on designing to facilitate production extends the discussion of machined parts. The manufacture of sheet metal parts by cold-working processes is taken up. The four basic processes used in the production of sheet metal parts—that is, cutting, bending, forming, and drawing—are described. As a prelude to a discussion of the various metalworking machines, brief consideration is given to the principal materials used for sheet metal parts. Since about 90 per cent of such parts are made of aluminum, aluminum alloys, and steel, the design limitations given are based on these materials. Metalworking machines described include metal shears, the radial router, the profiler, and the mechanical press. *Western Flying*, December, 1943, page 82, 84, 86, 88, 6 illus.



This 400-cycle, 35-kva. transformer has a rating of 250/30 volts and weighs but 25 lbs. The ruler shows its size. (*See* page 201.)

Electrical Equipment

Principles of Aircraft Electric-Motor Protection. V. G. Vaughan. The problem of protecting the aircraft electric motor from excessive temperatures is dealt with. It is noted that the major problem with the aircraft electric motor is to make available its maximum output before the protector disconnects the electric motor from the line.

Subjects discussed include the location of the protective device, the temperature at which to protect, the danger of hot-spot temperature, the thermal-element operating temperature, the function of the heat generated in the protector, and loads imposed on the motor. *Electrical Engineering*, December, 1943, pages 760–765 (Transactions), 12 illus.

Engines

Study of Exhaust-Valve Design from Gas Flow Standpoint. Seng-Chiu Hu. The object of the research described in this paper is to investigate the flow characteristics during the exhaust blowdown and to develop a rational background for designing and improving the present poppet-type exhaust valves of aircraft and automotive engines. The research was carried out in three main steps: (1) theoretic study of gas flow through exhaust valves; (2) experimental study of gas flow coefficient during exhaust blowdown; (3) correlation and discussion of the data obtained.

It is found that by means of a simple modification on a conventional valve, such as the valve from a C.F.R. engine, the maximum mass rate within the most useful range of the valve lift can be increased by at least 25 per cent. Such a gain could be obtained with no additional cost, since neither the diameter of the valve nor the size of the port need be changed.

In the course of the work a series of modifications of the profiles of valves and seats were investigated. The topics are: (1) stem fillet, (2) inner rounds (3) outer rounds, (4) head enlargement, (5) seat angle, and (6) profile of port approach. The records of their effects on valve performance are grouped, compared, and explained both graphically and theoretically in order to give a sound basis for exhaust-valve design.

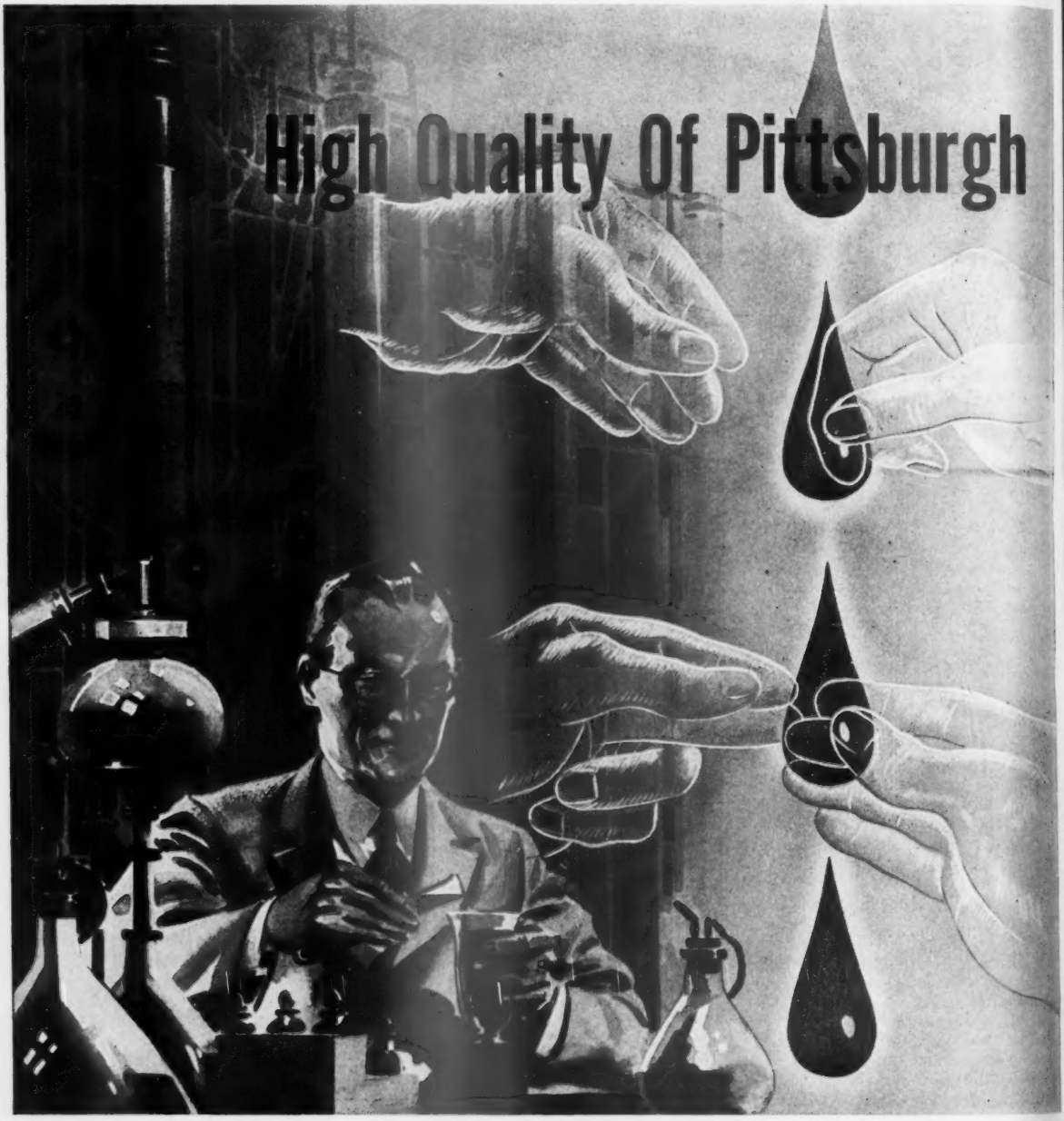
The pressure range investigated extends from critical pressure (atmospheric pressure/0.53) up to 80 lbs. per sq.in. It covers the actual operating conditions of modern unsupercharged and moderately supercharged aircraft, as well as automotive engines. Experiments agreeing with the theory indicate that the flow coefficient is almost independent of, and increases slightly with, the initial pressure. The results of this research, therefore, can be successfully applied on the safe side, to prospective highly supercharged engines with an exhaust pressure higher than 80 lbs. per sq.in. *Journal of the Aeronautical Sciences*, January, 1944, pages 13–20, 19 illus.

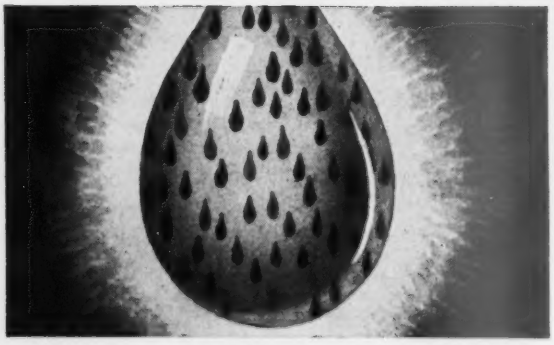
Operating Temperatures and Stresses of Aluminum Aircraft-Engine Parts. E. J. Willis and R. G. Anderson. It is stated that modern aircraft engines must be designed to give the maximum output with the minimum weight and that in order to help attain this goal a more definite knowledge of the temperatures and stresses under which the engine operates is desirable. A method developed to establish the operating temperatures of aluminum cylinder heads and pistons is described. The method takes advantage of the fact that the Brinell hardness of the cylinder head and piston decreases with the number of hours of service and the temperature at which the part operates. The stresses under which parts operate were also studied through the use of the brittle lacquer method, extensometers, and wire strain gauges. It is stated that of these three the brittle lacquer method proved the most satisfactory.

It is noted that, since most of the stresses in pistons are of a fatigue nature, pistons should be designed on a basis of the material's fatigue strength at the temperature of operation.

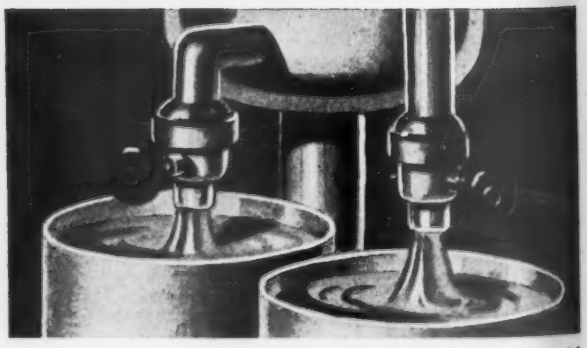
To study fatigue stresses, use was made of a hydraulically operated fatigue testing machine, which can produce up to 100,000 lbs. of load in either or both directions between the master piston and the bolster plate at 1,300 cycles per min. The part to be tested is placed in the machine with its head against a cushion with an appropriate connecting rod.

Electric heaters, properly controlled, were used to simulate operating temperatures of the piston. It is explained that it is quite necessary to maintain the same temperature gradients throughout the piston to produce failures com-



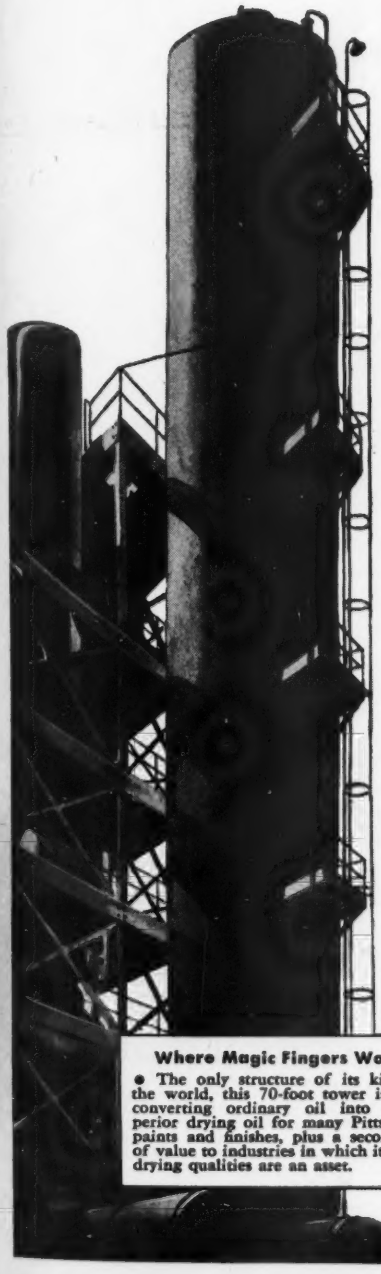


Inside Story of Oil—This diagram shows the "dual nature" of a drop of good quality linseed oil. The dark "droplets" represent molecules that are more valuable for paint-making. The lighter ones indicate molecules which are less desirable in a paint film but possess other commercial applications.



Two Oils From One—As if possessed of magic fingers, a special solvent divides each drop of oil and selects the molecules that are most useful for paint making. The result is that two streams of different oils, never before available, flow from the tower. One is an improved drying oil urgently needed for high-quality paints.

Aircraft Finishes Assured By New "Molecular-Selection" Process



Where Magic Fingers Work

● The only structure of its kind in the world, this 70-foot tower is now converting ordinary oil into a superior drying oil for many Pittsburgh paints and finishes, plus a second oil of value to industries in which its non-drying qualities are an asset.

As if by magic fingers, a complex natural oil is taken apart to produce a superior drying oil urgently needed for Pittsburgh Aircraft Finishes

THE toughness and all-round goodness of any aircraft finish depend to a high degree on the quality of the oil that goes into it. That is why Pittsburgh's pioneer work in developing the "molecular-selection" process, which provides brand new oil products superior to nature's best, is of such vital importance to the entire aviation industry.

"Magic Fingers" In Action

"Molecular selection" starts with natural oil rising in continuous flow in a 70-foot tower. At the same time, a special solvent cascades down through the tower. As if possessed of magic fingers, this solvent reaches into the drops of oil—seeks out and selects those molecules that are best suited to paint-making — segregates the molecules that add nothing to a paint film.

One natural oil enters this tower—two entirely new oils come out. The first is a superior paint-making oil which vastly improves the drying qualities of Pittsburgh Aircraft Finishes and enables Pittsburgh to control uniformity of paint performance. The second oil is of value to other industries.

Today thousands of gallons of Pittsburgh war finishes are in service on all types of bombers and combat planes. Pittsburgh's exclusive "molecular-selection" oils are one of several factors making it possible to produce Aircraft Finishes that frequently exceed minimum specification requirements.

Expert Advisory Service

Our technical men are always available for consultation—without charge or obligation. Their vast experience in the aviation field can save you time and money. Whenever you need help, get in touch with us immediately. Pittsburgh Plate Glass Company, Industrial Paint Div., Pittsburgh, Pa.

War—and Paint

Vast quantities of Pittsburgh War Finishes are being supplied for all types of equipment used in global warfare. Pittsburgh's experience, accumulated through years of persistent research, has been called upon again and again to assist in the solution of the vital paint problems that have arisen and to improve standards of war-paint quality and performance.

PITTSBURGH PLATE GLASS COMPANY, Industrial Paint Division, Pittsburgh, Pa. Factories: Milwaukee, Wis.; Newark, N. J.; Houston, Texas; Los Angeles, Calif.; Portland, Ore. Ditzler Color Division, Detroit, Mich. The Thresher Varnish Co., Dayton, O.

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PITTSBURGH STANDS FOR QUALITY PAINT AND GLASS

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Aircraft control systems by G.E. are designed with the emphasis on simplification in order to help you reduce weight and conserve space, with no sacrifice in operating efficiency. By careful engineering, it is often possible for us to combine the functions of several devices and further simplify the circuit.

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1. You greatly simplify your ordering

No need to specify what devices you require—just tell us what the control system must do. We have a complete line of devices, everything you need for electric control.

2. You save man power and plant space

By having us assemble, wire, and test the control systems for your aircraft, you take advantage of our experienced personnel and avoid doing this specialized work in your plant.

DON'T OVERLOOK the advantages of ready-built control systems. They offer more than a convenient way of ordering. Contact our nearest office—our engineers will be glad to tell you more about G-E packaged systems. *General Electric Company, Schenectady, N. Y.*

Every week 192,000 G-E employees purchase more than a million dollars' worth of War Bonds.

GENERAL ELECTRIC

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parable to those occurring in service. *S.A.E. Journal*, January, 1944, pages 28–36 (Transactions), 27 illus.

Improvements in German DB-601N Aircraft Engine. M. W. Bourdon. Information is given on the type DB-601N engine, a development of the DB-601A, which has been found in late models of the Me 109E and 109F shot down in England. The most important changes are stated to be an increase in the compression ratio (from 6.9 to 7.9) and the addition of more automatic controls. Some changes in bearing and gear-box design are listed. Sections of the article are devoted to the coolant system, the new oil tank, the thermostatic control of the oil cooler, the coolant-temperature control, and the air intake, cowling, and exhaust stubs. The information is based on an official British report. *Automotive and Aviation Industries*, December 1, 1943, pages 22–25, 7 illus.

Ranger Service from Policy to Performance. Paul E. Battilana. An account of how the Service Division of Ranger Aircraft Engines Division operates to supply customers with maintenance instructions, overhaul information, special tools, assistance in servicing problems, etc. Divided among six departments, activities of the division are coordinated under the service management. Functions of the Publications Department, Service Tool Department, Failed-Parts Department, Service School, Service Overhaul Shop, and Field Service Departments are outlined. *Aviation*, December, 1943, pages 151–153, 348, 351, 6 illus.

The Rotol "A.G.P." This article is concerned with details of a new auxiliary generating plant produced by Rotol Airscrews, Ltd. With an output of 20-kw. continuous rating, this unit complies with the manufacturer's scheme that all aircraft services be operated by independent electric motors located where most convenient, that power for their operation be supplied by one or more main generating plants placed in the hull or fuselage of the aircraft, and that an alternate set be placed in one engine compartment with the switch gear so arranged that the flight engineer can switch the load from one set to the other without interrupting the supply. Basically the A.G.P. unit is reported to comprise a gasoline engine that drives two electric generators, an alternator coupled direct to the crankshaft, and a d.c. generator mounted above the alternator and gear driven from the engine. A third generator, built in tandem with the second, is used to provide excitation for the alternator. To prevent the escape of fumes into the fuselage or hull of the aircraft, the entire equipment is enclosed in a sound-proofed box which is vented directly to the exterior of the aircraft. A major part of the description is devoted to particulars on the generators and the sleeve-valve engine. *Flight*, November 4, 1943, pages 500, 501, 4 illus.; "Independent Auxiliary Power," *The Aeroplane*, November 5, 1942, page 516, 1 illus.; "Auxiliary Power Unit," *Aircraft Production*, December, 1943, page 594, 1 illus.

Gauging of the end play of a connecting rod is simplified by service instructions of the Ranger Aircraft Engines Division.

Do's and Don'ts in Engine Repair. D. K. Morris. Fundamental rules for the maintenance of aircraft engines are suggested to the civilian flyer. The following advice is elaborated upon:

(1) Service operations on your plane or engine should be done by licensed mechanics only. (2) Have your service work of overhaul done only where there is access to completely modern, specialized aircraft service equipment. (3) Don't accept parts unless they are approved by the Civil Aeronautics Authority. (4) Question thoroughly any part offered for sale which has been made reusable by a mechanical practice not approved by C.A.A. (5) Don't substitute parts made by others for those originally furnished by the factory. (6) Don't accept any vital steel part for use in your engine unless it has been magnetically inspected by an approved service depot. (7) Don't gamble on "special" price propositions for aircraft engine overhauls. (8) Don't complete an engine overhaul without an equally thorough servicing and test of magneto and carburetor. (9) Have your service and overhaul work done only in those places where you will be allowed to see just how it is done. (10) Don't buy used parts unless they have been "cleaned" to the bare metal and thoroughly inspected before being reconditioned. Further suggestions are: Double check reconditioned parts offered for sale by the square, sharp edges of keyways, spline groves, etc. Look to see that gear teeth are nonpitted. Ask for measurement of wear at all bearing points or places of concentrated stress or load. Call for micrometer readings, especially on parts that are case-hardened. *Western Flying*, December, 1943, pages 54, 55, 120, 4 illus.

Is the New Engine-Warmer the Answer to Winter Flying Problems? Published in advance of manufacture, details are given on a newly patented device for keeping engines warmed up and ready for use. The stated objects of the invention are to provide simple and efficient means whereby the water and oil used in the cooling and lubricating systems of an internal combustion engine may be easily and quickly transferred from the cooling system, after the engine has been stopped, to an insulated auxiliary tank for storage during any inoperative period. There it can be kept in a heated condition pending further operation of the engine, at which time it may be quickly returned to the engine in a heated state to heat the engine block and insure easy starting, thus eliminating the necessity of using antifreeze. In describing the invention, reference is made to accompanying drawings. The specifications are reported under the following headings: auxiliary tank, valve casing, the valve, seating and housing, float control, stem and bracket, air vent, recoil switch, the plunger, pressure provision, coil spring, main valve stem, cylindric casing, partition outlet, operation, water flow, and emptying tank. *Commercial Aviation*, October, 1943, pages 144–146, 152, 2 illus.

"Per Cheetah Ad Astra." H. P. Wills. A review of the performance and service records of Cheetah aircraft engines in connection with Canada's combined training organization. The application of Cheetah engines in Anson I and Oxford planes is described. The article also includes data on the design and construction of these engines, their early development, and the difference between the IX and X models. *Commercial Aviation*, November, 1943, pages 69, 70, 72, 80, 8 illus.

Standard Aero Engine. A brief account of the activities, operating sequence, equipment features, facilities, and management of Standard Aero Engine Works Ltd. Located at Winnipeg, this engine and accessory servicing firm specializes in major overhaul of Jacobs engines. Total man-hour allotment is 60 per cent on engines and 40 per cent on accessories. A suggestion of the scheduling problem, as well as the variety of equipment skill required, is contained in a list of the auxiliary equipment that the company overhauls. *Canadian Aviation*, November, 1943, pages 92, 93, 3 illus.; "From Bush League to Majors," *Commercial Aviation*, October, 1943, pages 124, 126, 5 illus.

Flight Technique

Transition. V. Wolfgang Langewiesche. The fifth in a series of articles on the transition of the student pilot from the lighter training planes to the heavier units is concerned with engine power. It is stated that the problems of power are not direct but

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Every part of every Cannon Connector is rigidly held to close tolerances through a well established quality control system.

Such precision not only assures absolutely dependable operations, but it is the main reason why original assemblies are made with ease, and why all parts are so easily interchangeable.

Take the AN line for instance: Split shells (pioneered by Cannon) of flawless alloys, fittings that are die-cast instead of stamped, contacts that are milled from bar stock to give close tolerance and low voltage drop.

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For easier assembly—for more dependable service—use Cannon Plugs for all electric circuit connections.

CANNON BATTERY CONNECTOR—GB-3-34B Receptacle and GB-3-21B Plug shown at left are adapted to general industrial uses as well as quick disconnect of engine starting units in aircraft. This Cannon line covers a wide variety of types which are listed in the New Battery Connector Bulletin—free upon request. Address Department A-105, Cannon Electric Development Co., 3209 Humboldt St., Los Angeles 31, California.

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have a bearing on the stability and other control factors of the plane. The relationship of engine power to the performance of an airplane is explained in stages, beginning with the action of a "perfectly behaved" small airplane and proceeding to the peculiarities of the large, powerful craft. The effects of throttle setting and power on trim speed, the working of the trim tab, and stability are outlined, with examples of what happens under the conditions mentioned. A most important factor is that the pressure and position of the stick lose their value as clues to the speed of a more powerful plane. A discussion of the effects of the slipstream is included. Weakened stability or actual instability in slow flight with power on is held to be one of the few new factors likely to be encountered when making the transition from small, light training planes to large, powerful aircraft. *Air Facts*, January, 1944, pages 49–70, 10 illus.

The Sequence. Part III. George R. Clay. The concluding article of a series of three on the sequence of flight as it is set out in the C.A.A. training manuals. Part III contains advice for performing the sequence series of turns, the series of stalls (including Nos. 1, 2, and 3 power-on stall and Nos. 1, 2, and 3 power-off stalls), the spin, the spiral, the 180° side approach, and landing. *Southern Flight*, December, 1943, pages 48–50, 64, 3 illus.

Formation Flying for CAP Pilots. Walter X. Brennan. Information is given on formation flying, based on what little has been published about the subject and on the experience of the writer. Illustrations show various flight formations. Leaders' signals for formation flight are listed. *Aviation and Yachting*, December, 1943, pages 25, 27, 3 illus.

High Speed Stall. Lloyd Sloan. This one of a series of articles on fundamentals of flight is concerned with the question of excessive loadings on aircraft structures. It is mathematically shown how overstress, caused by maneuvering or by flight through gust conditions can cause the safety factor built into a given airplane to be exceeded. The hypothetic aircraft used as a basis for the calculations is said to approximate the specifications and flying characteristics of a popular twin-engined trainer. *Canadian Aviation*, December, 1943, pages 86, 88, 2 illus.

Flight Testing

Are Test Pilots Glamor Boys? A. Eriss. In this article it is stated that the test pilot of today is not a daredevil who is willing to go up in a dangerous plane. The writer explains that the modern test pilot will not go up in an aircraft that does not fly perfectly "on paper." Recklessness might lead to the damaging or destruction of a needed plane and set back the program of the Army Air Forces, it is stated. An outline is given of how

More information on crystal-clear Du Pont "Lucite" methyl methacrylate resin sheeting for aircraft designers, engineers, and suppliers of enclosures.

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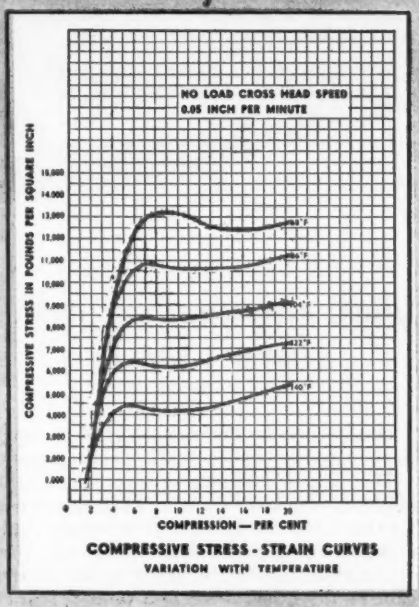

COMPRESSIVE STRESS-STRAIN CURVES
VARIATION WITH TEMPERATURE

METHOD OF MEASURING COMPRESSIVE STRENGTH

Du Pont plastics technicians determine the effect of temperature on the compressive strength of cast "Lucite" by A.S.T.M. method D 649-41T. A one-half-inch cube is compressed in a standard testing machine, the load applied at 0.05" per minute. As the load is increased, the amount of deformation is read from a dial gauge and a stress-strain curve is plotted. The load at the point of rupture (or at the first maximum of the curve) is taken as the strength of the half-inch cube, and the compressive strength per square inch of the material is arrived at by multiplying this value by four. The test is repeated at various temperatures obtained by placing the sample and the plates that compress it in a bath of electrically heated mineral oil.

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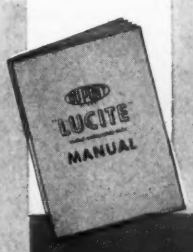

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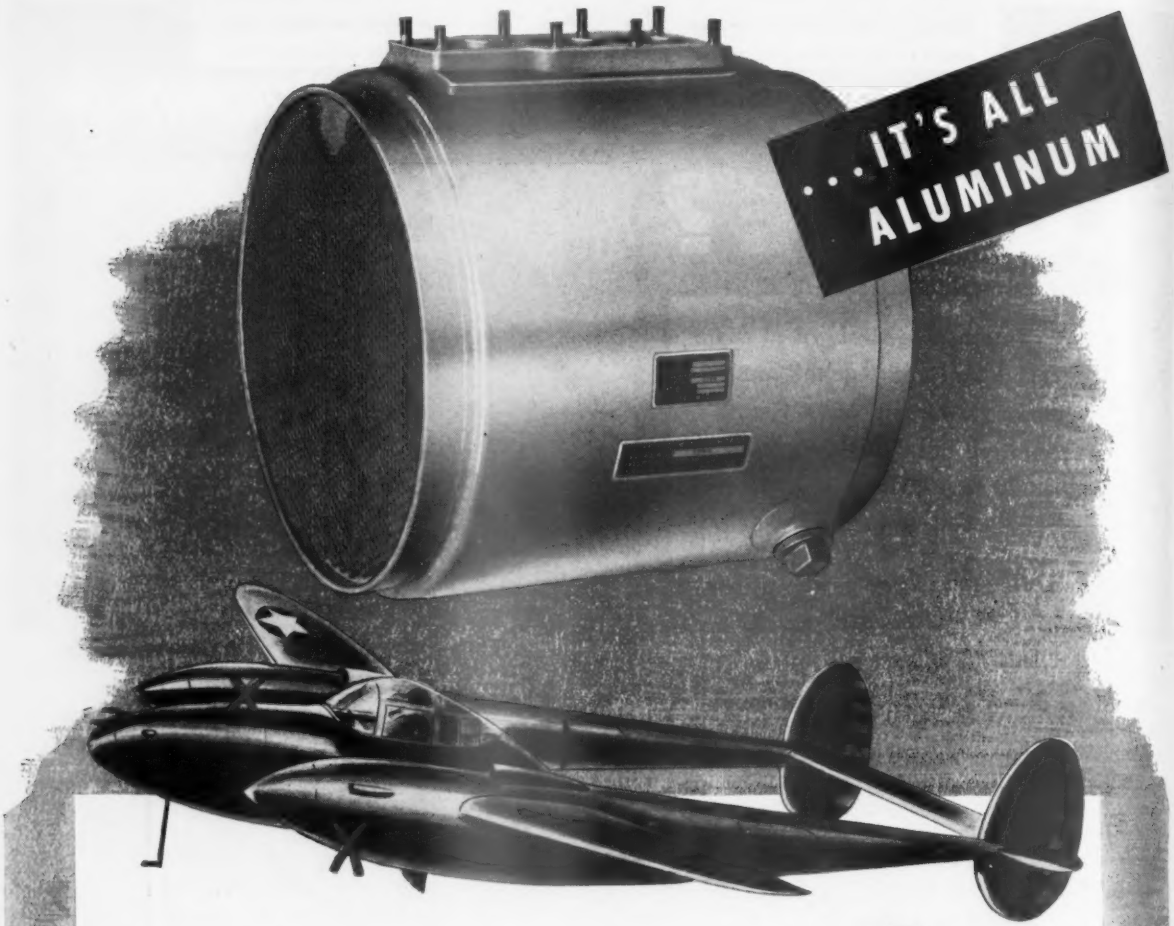

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planes are tested by the test pilot. *Aircraft Age*, February, 1944, pages 12, 13, 49, 50, 4 illus.

Fuels

Low Octane Gas. Civil Aeronautics Administration recommendations for avoiding the effects of leaded 73- and 80-octane gas on low-powered engines are briefed. Suggested preventive measures pertain to spark-plug fouling, sticking valves, sticking piston rings, overheating and detonation, corrosion, and general precautions. *Air Pilot & Technician*, November, 1943, pages 32, 53, 1 illus.

Pigeon Gas. Carl G. Hodges. A description is given of the development of a process for producing triptane or 2-2-3-trimethyl butane on a commercial basis. The advantages claimed for this aviation-engine fuel are outlined as an increase of 50 per cent in lift, of 25 per cent in speed, better rate of climb, ability to carry heavier armor or bomb loads, and relatively low cost. The characteristics of the fuel are described in nontechnical language. *Flying Aces*, February, 1944, pages 38, 60, 61, 3 illus.

Gliding and Soaring

The J-14 Twoplace. Volmer Jensen. A brief description is given of the J-14 two-place glider, which is a side-by-side utility trainer with a wing span of 45 ft. and strut-braced, semi-cantilever wings. It is stated that this glider flies efficiently at 35 m.p.h. The construction is almost entirely of wood, plywood being used only on the gusset plates in the leading edge of the wings. The general specifications are listed. *Soaring*, May-June, 1943, pages 12, 14, 1 illus.

Silent Partner of the Plane. Alden P. Armagnac. The development and current use of gliders and the value of the glider in military operations are discussed. How gliders have been used with success in certain military actions is described. It is stated that military experience has demonstrated the limitations, as well as the advantages, of gliders and that, with regard to towed gliders, trials seem to confirm the conservative opinion that for long hauls a powered plane alone will transport a load more efficiently. Nevertheless, gliders appear destined to play an important role in commercial aviation, closely paralleling their special military advantages. *Popular Science*, February, 1944, pages 94–101, 19 illus.

History

Kitty Hawk. Written in commemoration of the fortieth anniversary of the first flights in a heavier-than-air craft, made by the Wright Brothers on December 17, 1903, this article reviews the historic event. Details of the first flights made over the sand dunes at Kitty Hawk, N.C., are described. An outline is given

The views and opinions expressed in this section are exclusively those of the writers or publications named. They are in no case to be construed as those of the Aeronautical Engineering Review or the Institute of the Aeronautical Sciences.

of the life histories of Wilbur and Orville Wright. The article reveals the many difficulties and problems they had to overcome before their work could be brought to a successful conclusion. *The American Pilot*, December, 1943, pages 10–17, 16 illus.; "Forty Years of Heavier-Than-Air," *National Aeronautics*, December, 1943, pages 14, 15, 41, 4 illus.; "The Wright Brothers.... First of the Skymasters," *Aviation and Yachting*, December, 1943, pages 18, 19, 33, 48, 1 illus.; "Fortieth Anniversary," *Model Airplane News*, January, 1944, pages 11, 45, 46, 4 illus.; "The Birth of Aviation," *Aero Digest*, December, 1943, pages 113–115, 260, 262, 6 illus.; "The Revolution at Kitty Hawk," by Fred C. Kelly, *Technology Review*, December, 1943, pages 83, 84, 96, 1 illus.; "Kill Devil Hills," by Mary Merner, *Airlanes*, December, 1943, pages, 2, 3, 4 illus.

Pioneer. Frank H. Ellis. Successful experiments in aircraft design and building conducted in 1910 by William Wallace Gibson, who is called an unheralded Canadian pioneer, are reviewed. Details are given on his "twin-plane," built in 1910; his multiplane, built in 1911; and his two aircraft engines, one built in 1905–1908 and the other in 1910. The latter, a six-cylinder, 2-cycle, air-cooled engine, is claimed to be the first airplane engine of this type ever fabricated in Canada. Almost completely original, it is stated that Gibson's designs incorporated features that were not employed in aircraft until many years later. *Canadian Aviation*, November, 1943, pages 48–50, 114, 116, 118, 6 illus.

Flying as It Was. Harry Van Demark. With a narrative of some of their exploits, this is a roll-call of the adventurous pioneers who were professional aviators before the first World War. The men mentioned are mainly Americans. *Air Pilot & Technician*, November, 1943, pages 6–8, 11, 8 illus.

Hydraulics

Reduction of the Progressive Thinning of Hydraulic Tube Flares. Bernard J. McCabe. Noting the progressive increase in the operating pressure of aircraft hydraulic systems, the writer studies the obstacles now in the way of further increases from the present 1,500-lb. standard to a pressure of 3,000 lbs. One of the difficulties has been in the maintenance of tubes and fittings, in which connection the tube flare and its assembly are analyzed in an effort to determine the reasons for hydraulic failures at the fittings. Such failures are classified into two groups consisting of (1) discrepancies in manufacture between the drawings and specifications and the finished fittings and (2) mishandling or abusive handling of the units during the assembly of tubing and fittings. Numerous faults chargeable to the manufacturer are listed under the first group, while the second group is stated to account for the greatest number of failures because faulty assembly is almost impossible to locate in an installation. Thinning of the walls at the flare is named as the cause of many failures. Investigations are reported in connection with several different diameters of aluminum tubing and fittings, with information on the results of using harder materials and different sleeves and sleeve angles. Failures caused by improper assembly and careless workmanship are discussed and illustrated, and maximum wrench-torque values are tabulated. *Aero Digest*, December, 1943, pages 190, 192, 282, 284, 6 illus.

Fluid Drive. An explanation of the fundamental principles of hydraulic systems in their application to aircraft. Advantages of hydraulic operation over mechanical methods are cited and the possibilities of future development are examined. Speculation as to future use centers particularly about the employment of hydraulics for flight controls. *Flight*, November 25, 1943, pages 592–594, 5 illus.

Inspection

Scheduled Machine Inspections. Thomas E. Lloyd. A description is given of the plant facilities and inspection system used at the Buffalo parts and assemblies plant of the Bell Aircraft Corporation. It is stated that though periodically scheduled inspection of plant equipment is only 7 months old it has proved to be a vital factor in keeping plant production well ahead of the demand of the aircraft assembly lines. Information is given on inspection cycles and the benefits gained with the plan. Illustrations of the inspection-record and order forms are shown. *The Iron Age*, December 30, 1943, pages 28–31, 6 illus.

Instrument Flying

Applying the Theory of Instrument Flight. Edward A. Diffenbach. Referring to an earlier article that established two fundamental principles for instrument flight, the current article lists common errors resulting from inexperience and insufficient practice and suggests the maneuvers that would aid in building up the necessary experience. The operation and limitations of the gyro instruments are explained, and suggestions are made for controlling the attitude of the plane. How to make turns at steep angles of

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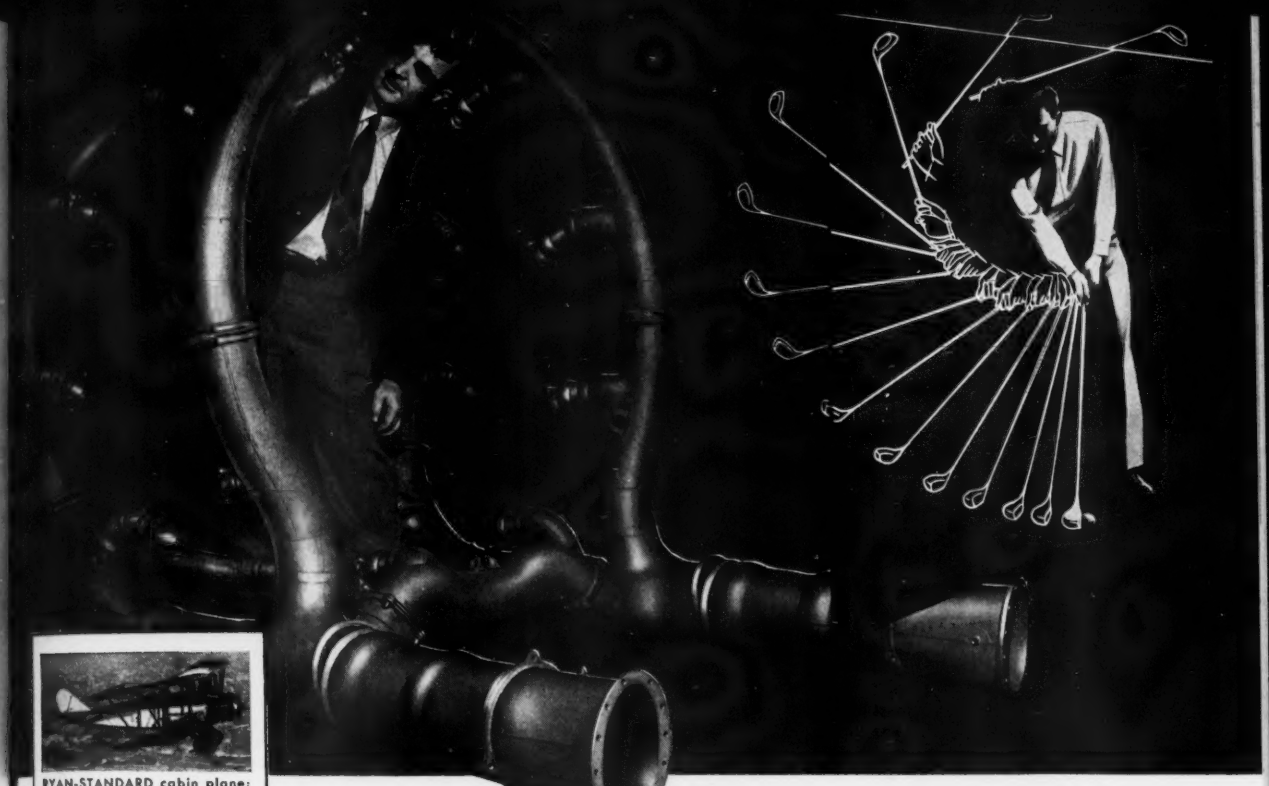
bank in level flight is outlined, followed by instruction in executing shallow and steep turns in climbs and dives. The next step is a combination of reversal of turn and reversal of climb, and another is leveling off from steep dives, or climbs while remaining in steep angles of bank. This is designated as Phase One in instrument training and should be mastered before attempting further maneuvers. Phase Two is designed to give the pilot a chance to establish an instrument reference to the ground in extreme attitudes, as well as to control the aircraft in these positions. Detailed instructions cover this phase, using the entire instrument panel and progressing to the use of the partial panel, excluding the artificial horizon and the directional gyro. It is emphasized that the pilot must be able to execute extreme maneuvers in order to attain positive control of the plane, after which it becomes easy for him to accomplish straight flight holding accurate headings. *Air Facts*, January, 1944, pages 32–39.

Instruments

Graphical Analysis of Response Characteristics of Rate-of-Climb Indicators. Kalman J. DeJuhasz. The static and dynamic response characteristics of the leak type rate-of-climb indicator have been determined with the aid of graphic analysis, the method has been applied to an actual instrument, and the results have been compared with those of mathematical analysis. Influence of altitude on the calibration coefficient is determined and the effects of compensating means discussed. *Journal of the Aeronautical Sciences*, January, 1944, pages 48–54, 10 illus.

Aircraft Instruments. Surveying the instruments of the standardized blind-flying panel, this article depicts the purpose of the instruments, briefly describes their construction, and explains the principles upon which they function. Special sections of the article are devoted to each of the following: the artificial horizon, the directional gyro, the air-speed indicator, the altimeter, the rate-of-climb indicator, the turn-and-bank indicator, and the magnetic compass. *Flight*, November 11, 1943, pages 534–539, 17 illus.

Aircraft Instruments. Part II. Following a study of flight instruments, the second part of this article deals with engine and ancillary service instruments. The purpose and operating principles of each instrument are explained in subdivided portions of the article devoted to individual treatment of each device. Engine instruments examined in Part II include: the centrifugal and electrical types of revolution indicators; the boost-pressure, oil-pressure, oil-temperature, and fuel-contents gauges; the fuel-feed warning light; and the engine-temperature gauges. Auxiliary service instruments considered are: the flap incidence indicator, undercarriage-position indicator, brake-pressure gauge, and oxygen-supply indicators. *Flight*,



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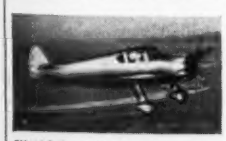
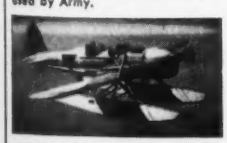
RYAN BLUEBIRD, cabin monoplane, forerunner of "Spirit of St. Louis"

RYAN S-T metal-fuselaged primary trainer; led trend to low-wing types.



RYAN S-C, cabin plane for private-owner use, featured all-metal construction.

RYAN STM, first low-wing primary trainer types (PT-16 and PT-20) used by Army.



RYAN STM-S2 seaplane, exported for training Naval pilots.

RYAN PT-25, superbly engineered plastic-bonded plywood trainer.

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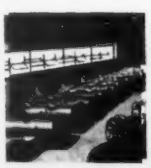

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November 18, 1943, pages 559–563, 16 illus.

Radium Luminous Compounds for Aircraft Instruments. An article on the products and manufacturing methods of Kirk Dial Ltd.—a firm that fabricates radium luminous compounds for aircraft instruments, gunsights, bombsights, etc. Besides being engaged in the production of dials, it is stated the company has been responsible for the perfecting of an improved manufacturing process for radium luminous glass tubes such as are used in guns, tanks, and torpedo sights. An important phase of its operations is the precision screening of dials, panels, nameplates, instructions plates, serial number plates, etc., including phosphorescent and fluorescent screening to R.C.A.F. specifications. At present Kirk Dial is also reported to be opening a new department that will specialize in the making of plastic dials with permanent engraved numbers and graduations that will not erase because the pigment is fused in through a special process. Information relative to the plant, personnel, and executives is included. *Commercial Aviation*, November, 1943, pages 114, 116, 6 illus.

Don't Fly by the Seat of Your Pants. Lt. Myron Eddy. A description is given of the flight, navigation, engine, and auxiliary instruments of aircraft and how to use them in flight. *Aircraft Age*, February, 1943, pages 28, 29, 57, 59, 7 illus.

Nerve Center of a Fortress. Major Allen V. Martini. A brief description is given of the many instruments with which the Flying Fortress is equipped, their various purposes, and how they are used. *Flying Aces*, February, 1944, pages 32, 33, 66–68, 4 illus.

Jet Propulsion

The Development of Jet or Rocket Propulsion. Translated by V. P. Akimoff. An article reprinted from *Flug-v. Wehr. Technik*, July-August, 1941, and published by permission of the British Ministry of Aircraft Production as R.T.F. translation No. 1330. The historical development of rocket propulsion is traced and the action of the rocket is described. The use of jet propulsion as the motive power for aircraft and motor cars is discussed. The latest Italian experiments with jet-propelled aircraft are outlined, and personal investigations made by the writer are set forth. A rather detailed summary of conclusions is presented, in which the writer considers the fuel consumption, which is stated to be heavy, the terminal velocity, acceleration, long-distance flights, and other subjects. *The Journal of The Royal Aeronautical Society*, December, 1943, pages 407–418, 2 illus.

Experiments in Jet Propulsion. Willy Ley. Presenting some brief data on the Caproni-Campini CC-2, the writer explains why this experiment in jet-propelled planes was a failure in spite of the fact that the CC-2 did fly. He shows that the Campini design depends on comparatively dense air for its operation and that, therefore, it cannot fly at a high enough altitude to achieve the high speed which is the chief goal of jet-propelled aircraft. Nor, on the other hand, are the low efficiency and low speed compensated by a large pay load.

The criticism of the Caproni-Campini patent is preceded by an account of two earlier jet-propulsion schemes. One, devised by René Lorin, called for a six-cylinder "pancake" in each wing, with six direct exhausts working alternately. The other was the reaction engine designed by Henri Melot. *Western Flying*, December, 1943, pages 48, 49, 100, 4 illus.

The Shape of War to Come. Paul James. Fundamental principles of jet-propelled planes are explained. Data are given on the Caproni-Campini model flown from Milan to Rome last winter and on the recently patented Hahn-Heinkel unit. Attention is directed to the fact that jet-propelled aircraft are particularly adaptable to high-speed conditions because while they are not especially efficient at subsonic speeds, when supersonic speeds are approached the discharge gases make use of their full kinetic energy. *Canadian Aviation*, November, 1943, pages 57, 58, 134, 4 illus.

Lighter-Than-Air

Goodyear M-1 Blimp Begins Test Flights. Some brief information is presented on Goodyear's M-1 blimp, now undergoing test flights. With a 650,000 cu.ft. gas capacity, the M-1 is only 40 ft. longer than the K-blimps currently used in coastal patrol work but can contain 50 per cent more helium, giving a substantial increase in cruising range and load. It is also reported to be faster than the K-type. Principal differences between the two blimps is in the operating car. Three times as long as that of the K-blimp, the M-1 car is built in three connecting units. These are integrated by universal joints to allow freedom of motion in coordination with the flexible gas envelope. *Aviation*, December, 1943, page 230, 1 illus.

Flying Flat-Tops. Hugh Allen. The development of a dirigible aircraft carrier is suggested. It would be of the rigid type with a capacity of about 10,000,000 cu.ft. of gas. Airplanes would be fastened to the belly of the dirigible by means of hooks.

The many ways in which such a lighter-than-air carrier could be used are outlined. It is noted that unlike surface carriers the dirigible carrier would not be subjected to the hazards of torpedoes, mines, or surface fire. As the helium gas would be distributed in numerous cells, it is stated that a reasonable number of hits by bullets would not result in an appreciable loss of lifting gas. *Air Trails*, January, 1944, pages 13–15, 99, 100, 3 illus.

Windjammers of the Sky. This article outlines how naval aviation cadets are being trained at such lighter-than-air bases as Moffett Field, Calif., in the use of free ballons. Such balloons are used as a basis for training crews to fly blimps for antisubmarine patrol and other purposes. Conditions that must be overcome in navigating balloons are described. *Popular Mechanics*, January, 1944, pages 8–13, 10 illus.

Maintenance

Manufacturing and Maintenance Join Hands. Donald S. Sprague. A survey of the organization and functions of the Douglas Aircraft Company's service department. The following functions are included in those examined: preparing and furnishing technical data to military and commercial operators; issuing instructions for, and supervising, the salvage and repair of the damaged aircraft; analyzing reports from operators on failures and malfunctioning of parts of the airplane; initiating suitable corrective action to eliminate such troubles; supervising modifications on delivered airplanes; consulting engineers with regard to problems that arise during operation of airplanes; assisting in the solution of these problems through redesign on future models; and, providing through field service representatives assistance to both military and commercial operators in the United States and abroad. *Aviation*, December, 1943, pages 120–123, 327, 328, 11 illus.

Maintenance of Aircraft Control Cords and Cables. A. J. Morgan. Information is given on the installation and maintenance of the control cords and cables used in aircraft. Sections discuss the storage of cord, uncoiling and unreeling, cutting the cord and attaching the fittings, pulleys and fairleads, adjusting the tension, inspection, and salvage. *Aviation Maintenance*, January, 1944, pages 61–63, 7 illus.

Efficiency Is Keynote at Aircraft Repair Limited. Ronald A. Keith. This article on the Canadian company of Aircraft Repair Ltd. deals with the overhaul organization's growth in the past 2½ years, its executive personnel, the production principles that have been applied to repair and fabricating operations, the main assembly and subassembly techniques used, and some of the special devices that have been innovated for greater production efficiency. It also covers the company's field repair service and the engine-overhaul division.

The activities of Aircraft Repair Ltd. are reported to include air-frame and engine overhaul, as well as special subcontracting. Although air-frame overhaul is concentrated chiefly on the Airspeed Oxford and the Avro Anson, 36

other aircraft types have been handled since January 1, 1943. Engines that come in for time-expired overhaul include Cheetah LX and X, Pratt & Whitney Wasp, Jacobs L4 and L6, Wright Cyclone and Whirlwind, Lycoming, and Continental models. As special subcontract work, the company is producing an originally designed and patented ski-wheel combination for U.S. Army use in Alaska, engine mounts for Federal Aircraft, and Cheetah engine link-rod pins. *Canadian Aviation*, November, 1943, pages 73, 74, 76, 8 illus.; "Aircraft Repair & Maintenance," *Commercial Aviation*, October, 1943, pages 71, 72, 74, 76, 13 illus.

"Sighted Wreck, Repaired Same." Myles V. Cave. The purpose, organization, and activities of the Advance Air Service are related. A subcommand of the 8th Air Force Service Command, the A.A.S. consists of mobile service units that travel all over England to repair forced-down aircraft returning from combat missions and which are assigned to various jobs by a central control board after a preliminary investigation of the damaged planes. This process of taking the repair depot to the plane is said to represent a great saving of time and work over the former method of transporting the damaged aircraft to the repair depot.

A complete mobile service unit is reported to consist of the following vehicles: (1) large truck and trailer equipped as a machine shop, with various tool equipment described in the article; (2) large truck and trailer of similar design fitted out as a store for bar and sheet material, small parts, tools, etc.; (3) large truck and trailer fitted out with a kitchen and bunks for the 19 men who make up the personnel of the unit; (4) two jeeps for collecting necessary material and contacting nearby airfields; (5) one 2½-ton truck for hauling heavy material and transporting personnel; (6) reconnaissance cars for transporting men from job to job; (7) truck with 420-gal. water tank for drinking and cooking; and (8) a traveling crane, which is available if required. *Aviation*, December, 1943, pages 124–127, 308, 311, 11 illus.; "Field Maintenance . . . . . The Mobile Instrument Shop," *Aviation Maintenance*, January, 1944, pages 66, 67, 114, 8 illus.

On the Beam—Mechanically. Earl F. Theisinger. Air-line maintenance as it is carried out by American Airlines is described. As an example of what maintenance means to modern air transport, operations in the hangars at LaGuardia Field are outlined. The article reveals how a fleet of 44 DC-3 transport planes are kept in proper mechanical condition. It is explained that nine of these planes are customarily out of service for various routine maintenance operations and for reserve assignments. Sections of the article discuss the organization of the maintenance department, the men responsible for what goes on in the overhaul plant, and the mechanics who must carry out the work in the shortest possible time. Other sections cover inspection routine, double engine change, the replacement of parts, and maintenance production. *Air Transport*, December, 1943, pages 20–28, 14 illus.; "American Airlines Maintenance," *Aviation Maintenance*, January, 1944, pages 25–34, 14 illus.

Moose Jaw Plant Keeps "Cranes" in the Air. A report of how a Canadian overhaul base specializing in the maintenance and repair of Cessna "Cranes" for the R.C.A.F. functions. The repair procedures examined are those of the Moose Jaw Plant operated by Prairie Air Ltd. Emphasis is placed upon the similarity between the methods employed, physical setup, and work done at Moose Jaw and at the Cessna plant in Wichita. *Commercial Aviation*, October, 1943, pages, 86, 88, 8 illus.

Granulated Tenite pellets used by the Army Air Forces to blast carbon from pistons. (*See* page 197.)

Maintaining Sub Killers. Lt. Comdr. Robert E. Huse. A detailed article on the maintenance and repair of U.S. Navy blimps. As typified by the work of the Assembly & Repair Department of the naval overhaul and operations base at Richmond, Fla., the complete routines of interim overhauls (scheduled after approximately 1,000 hours of flight time) and major overhauls (scheduled after approximately 3,000 hours of flight time) are traced. In addition to overhaul, maintenance, testing, and emergency repair procedures, the article describes the manufacture of repair parts and changes carried on by the department. Information is also given on: machinery, tools, and equipment; the organization and administration of A. & R.; personnel; and the different shops, offices, and subdivisions of which the department is composed. *Aviation*, December, 1943, pages 128, 135, 321, 323, 324, 327, 23 illus.

Royal Air Force Salvage Methods for Damaged Airplanes. G. E. Lywod. A continuation of an article on the maintenance and salvage of British combat planes. Information is given on the salvage and repair of damaged propellers and propeller components. *Aviation Maintenance*, January, 1944, pages 52, 53, 8 illus.

Oldest Air Transport Company in Canada. The history and current operations of the M. & C. Aviation Company are briefly recounted. Noted as the oldest air transport company in Canada, the firm at present is engaged primarily in overhauling and repairing aircraft. The firm also manufactures many of the parts needed for the repair operations. It is stated that practically every major modification on the Gypsy Major engine has originated from the M. & C. plant. *Commercial Aviation*, October, 1943, pages 126, 128, 130, 10 illus.

Crew Competition Speeds Maintenance. James Montagnes. The Royal Canadian Air Force system of maintaining aircraft is covered in this article. Based upon the principle of having the smallest number of planes grounded for the least possible time, the system incorporates a number of incentive features for increasing the efficiency of personnel. Stores and control operations are located in the center of each hangar, with aircraft arriving for repair and overhaul routed counterclockwise around the hangar.

Working procedures, methods of advancing and promoting crewmen, and training plans are noted. Brief details are also given on a number of devices, perfected at R.C.A.F. stations, which facilitate the operations. These include: wooden-wheeled carriers for fire extinguishers; a box on the portable spraying machine for carrying replacements of paint or dope; metal stepladders on gasoline-truck front fenders so that mechanics can fuel training aircraft without stepping on the wing walks; and the emptying of gasoline from aircraft by means of specially constructed wood and metal trucks on castor wheels. *Aviation*, December, 1943, pages 148–150, 311, 312, 315, 11 illus.; "Double Check," *Canadian Aviation*, November, 1943, page 51, 6 illus.

Safely Into Service. Andrew R. Boone. The maintenance of aircraft in war theaters is described in this article on the field servicing of Boeing bombers. *Air Trails*, January, 1944, pages 22, 23, 72, 74, 76, 7 illus.

Receiving, Handling, Inspecting and Storing Airplane Glasses. Information is given on how glass for aircraft should be handled, inspected, and stored. Storage racks and checking fixtures are illustrated. Instructions for the handling of glass in the shop are listed. Specific suggestions are given for the handling and storage of glass with extended plastic edges, which is known as Flexseal safety glass. *Aviation Maintenance*, January, 1944, pages 50, 51, 114, 116, 4 illus.

Combat Maintenance is Tough. Clyde R. Paton and William C. Gould.

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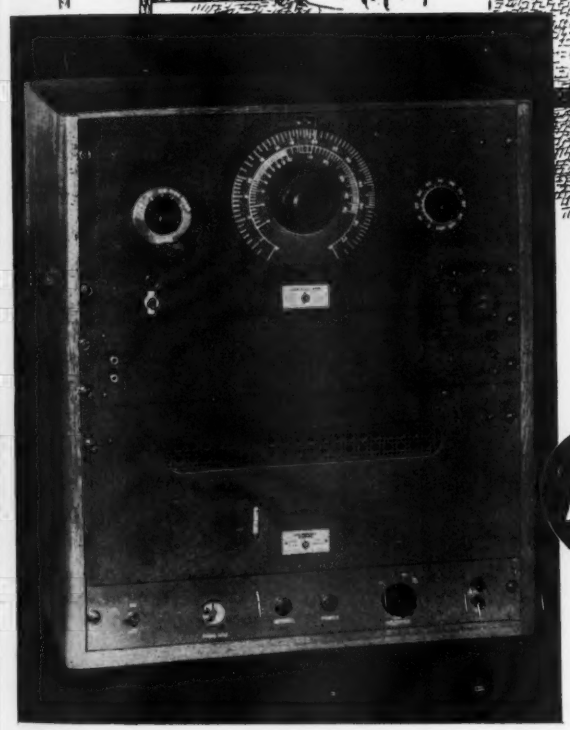

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Offering both general and specific suggestions for improvements the writers report their eyewitness observations on overseas field service conditions and problems. Their comments include recommendations for: adequate air-cleaner equipment at all engine openings; the designing of aircraft to be based upon the easy service replacement of relatively small self-contained units, even if this type of design results in increased weight; separate flight schedules for personnel and material; the development of salvage procedures requiring only simple, readily portable hand tools that can be utilized under primitive conditions; greater attention to service-installation time and protection from dirt and humidity in the design of power plants; and the use of electrical rather than hydraulic equipment. *Flying*, January, 1944, pages 54–56, 106, 111, 3 illus.

Engineering Aspects of Airline Maintenance. David North. Superior operating results are traced to the liaison between the maintenance and engineering departments of American Airlines. Outlining the specific responsibilities of each department to the other, the writer explains how the support of one department not only improves the work of the other but also produces a greater overall efficiency. The system is illustrated by an outline of how an aeronautical idea, hypothetically conceived by a mechanic on the job, would be routed to completion. Functions of intermediary engineers in effecting the coordination between the two departments are noted. *Aviation*, December, 1943, pages 136, 137, 344, 347, 348, 1 illus.

How Technicians Keep Bombers Flying. A description of how field representatives are trained to make quick repairs on Consolidated Vultee bombers at war fronts. The article outlines the way men whose vocations have given them experience in the construction and maintenance of heavy military aircraft are trained as field technicians at San Diego. *Air Pilot and Technician*, December, 1943, pages 6–8, 18, 5 illus.

Navy Uses Microfilming to Aid Repair. A description of how the Navy is using aircraft engineering drawings reproduced on films to provide information for distant maintenance bases. Through the use of microphotography, the Navy has reduced tons of blueprints to compact rolls of film, easy to transport, of little weight, simple to file, and available for ready reference. *Aviation Maintenance*, January, 1944, pages 70, 71, 9 illus.

They're Trained to Fix It Under Fire. A series of photographs illustrates the conditions under which mechanics at the Army Air Forces School of Applied Tactics are trained to repair aircraft. Simulating those of actual combat, these conditions require that the men work out in the field, live in tents and huts, use emergency equipment, and operate under constant threat of air attack. *Aviation*, December, 1943, pages 138–141, 15 illus.

CAA Inspects for Safety. A. F. Notley. Inspection of the repair and maintenance of civil aircraft as it is carried out by Civil Aeronautics Administration inspectors is described. The responsibilities of the aeronautical inspectors and air-carrier inspectors, who check aircraft to see that both private and commercial planes conform to safety standards, are outlined. *Aviation Maintenance*, January, 1944, pages 48, 49, 142, 144, 146, 6 illus.

Navy Ingenuity in Propeller Maintenance. Accompanied by descriptions, several sketches and photographs are shown of creative tool designs used at the Jacksonville Naval Air Station propeller shop. These include illustrations of a special buffing machine, a propeller-blade cart, and a piston gasket nut wrench. The efficient arrangement of facilities, separating buffing operations from the main shop, is also depicted. *Aviation*, December, 1943, pages 142, 143, 6 illus.

Repairs on Site. C. Davis. A study of how on-the-spot repairs to aircraft can be expedited and the aircraft returned to service as quickly as possible by organized working procedure. The article is concerned with three phases of the paper work involved: the record charts and the desk work relative to the organization of the repair

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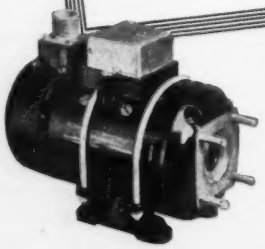
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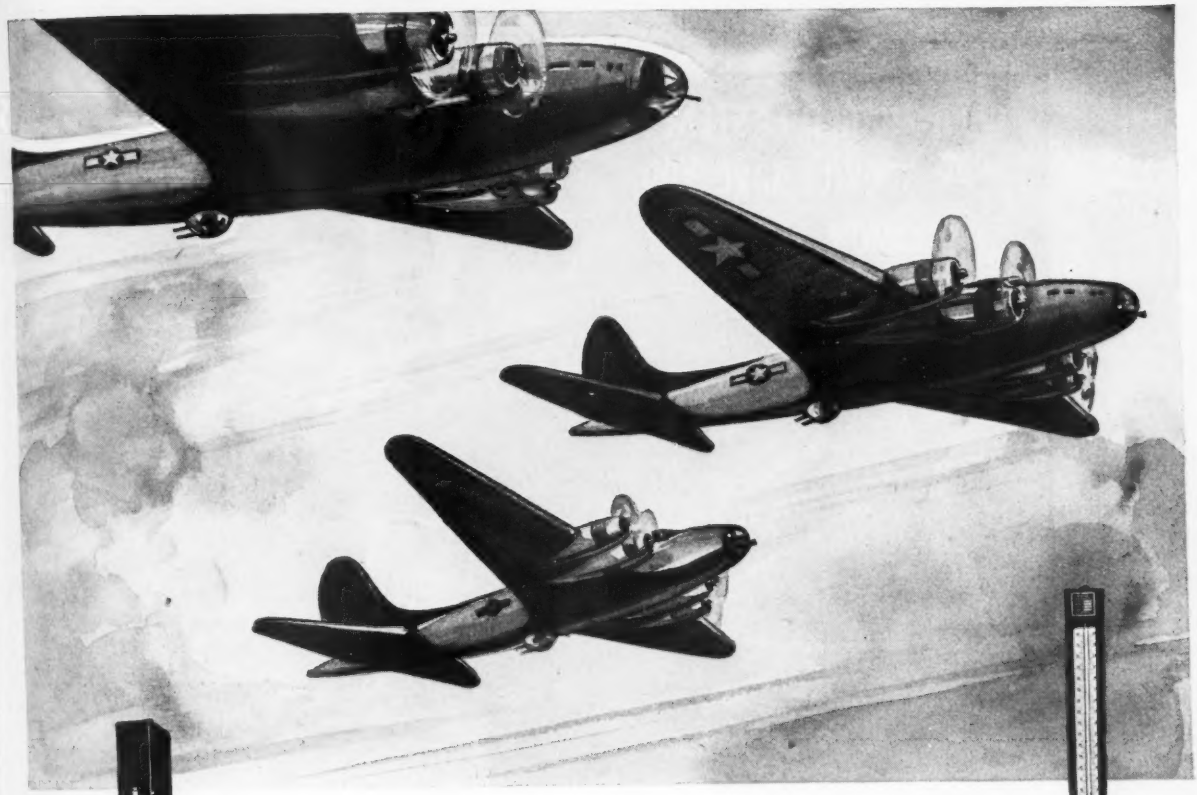

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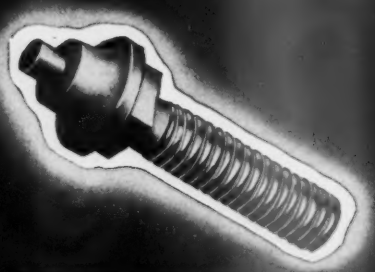

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crews and that covering the transportation of personnel to the site of repair. Two suggested types of charts are illustrated: one on which is recorded the history of each airplane from the time it is signalled until repairs are completed; and the other reporting the progress of repairs. *Aircraft Production*, December, 1943, pages 601–603, 2 illus.

Airline Maintenance "In the Bush." The elasticity of the Canadian Pacific Airlines maintenance scheme is indicated by details on its inspection and overhaul routines for different routes. For its main-line runs, C.P.A. has established a regular four-period inspection system which is described. The No. 1 check is an en-route flight check; No. 2 takes place after 8 to 12 hours of flying time; No. 3, after 50–60 hours; and No. 4, after 200–210 hours. Typical bush maintenance operations are examplified as those of the C.P.A. Central Division, headquartered at Winnipeg. They involve inspections made daily before flight, after 25 to 30 hours of flying time, again after 50 to 60 hours, and between 180 to 200 hours. *Aviation*, December, 1943, pages 154, 155, 315, 316, 4 illus.

Management

Many Human Factors Affect Better Utilization of Labor. Herbert Chase. Methods that can be applied to overcome labor shortages in the aviation industry are discussed. Some of the human factors are considered and are summarized in a "check list" of questions. Subjects covered include incentive systems, merit systems, training upgrading, fitting workers to the job, the avoidance of worry and unnecessary fatigue, cyclic systems, absenteeism, and provisions for meeting Selective Service requirements. *Wings*, December, 1943, pages 794–797, 9 illus.

Let's Look at the Records. Descriptions and illustrations cover the 33 forms used by the Thompson Aircraft Products Company, division of Thompson Products, Inc., to simplify the handling of every phase of the employee's working life. The records begin with the factory-employment requisition and cover each step in the induction of a new employee, his training, and the history of his work. *Wings*, December, 1943, pages 785–787, 11 illus.

Materials

Metal Show Forecasts New Horizons. Herbert Chase. A survey of developments in metal as mentioned and exhibited at the Chicago War Conference Display. These are summarized with particular regard to their applications in the aircraft industry. Both new techniques and new alloys are reported. Among the developments noted are those concerning light metals, aluminum alloys, high-silicon alloys, magnesium alloys, zinc-bearing alloys, silver, beryllium, ferrous alloys, carburizing seels, "liquid forgings," nickel-iron castings produced in sand, and stainless steel. Some of the major companies which participated in the display are named. *Aviation*, December, 1943, pages 194, 316, 319, 320, 321.

Medicine

Medical Activities in Military Aviation. Otis O. Benson, Jr., David B. Dill, and W. Randolph Lovelace II. The functions and the scope of the activities of the aviation medical officer are defined, the problems that confront the medical officer are surveyed, and the lines along which his efforts are directed are indicated. The principal problems are listed as: (1) selection of personnel of all flying categories and of technical groups; (2) training and indoctrination of personnel directly and indirectly concerned with flying; (3) maintenance of personnel of the air forces; (4) medical problems of flight; and (5) special problems occasioned by the present global war. Each of these problems is discussed in detail. *Journal of the Aeronautical Sciences*, January, 1944, pages 21–24, 66.

Medical Activities in Naval Aviation. J. C. Adams, B. Groesbeck, Jr., and E. F. DuBois. The methods established by the Navy for determining the physical and psychologic fitness of candidates for naval aviation are reviewed. After brief comments upon the physical and mental limitations of the human that make it difficult for him to keep up with the engineering advancements in aircraft performance, the paper gives information on pilot selection, altitude problems, night vision, pilot fatigue, aviation medical research, physiologic limitation and problems, and crash hazards. It is stated that these are some of the problems requiring the cooperation of the doctor, the engineer, and the industry, but others also fit into the general picture. Much has been accomplished by the careful selection of air crews and flight surgeons and by the development of new equipment, but the planes have driven the pilots to their physiologic limits. Additional adjustment must come in large measure through engineering improvements in aircraft and equipment to bridge the gap between human limitations and the advances in aircraft performance. *Journal of the Aeronautical Sciences*, January, 1944, pages 63–66.

How Aviation Medicine Is Reducing the Hazards of Flying. The processes of selection and examination by which aviation medical officers determine the fitness of candidates for military flying are outlined. The flight surgeons are given credit comparable with that given to the commanding officers for the success of modern aerial warfare, because they are responsible for the physical and mental capability of the airmen. The article relates the qualifications demanded of aviation medical officers and of the men who are to compose the flight crews, with information on the unusual strains to which combat aviators are subject and the physical and mental abilities they must have to perform their duties properly. Details are given on the physical, psychologic, and neuropsychiatric examinations that must be passed and on the disturbances that contribute to failure. Information is included on the instruments and methods used in the examinations, as well as the remedial measures taken to maintain airmen in proper condition to carry out their duties. Emphasis is placed on the importance of the services of medical officers in safeguarding the lives and health of the pilots and the men who fly with them. *Aero Digest*, December, 1943, pages 116–119, 124, 234, 237, 284, 286, 19 illus.

Incidence of Dental Caries Among Aviation Cadets. Capt. William W. Senn. This article reveals the results of a dental caries survey conducted on aviation cadets of San Antonio Aviation Cadet Center, showing the caries incidence by states. It was felt that these men coming from various types of rural and urban environment should give a good cross section of the incidence of dental caries in these various localities. In the summary of the survey it is stated that from the data presented it is evident that fluorine may be an important factor in the prevention of dental caries. *The Military Surgeon*, December, 1943, pages 461–464, 2 illus.

Wirkung Hoher Fliehkraefte auf den Menschen im Sturzkampfflugzeug (Effect of Strong Centrifugal Forces on the Human Organism in a Dive Bomber). H. von Diringshofen (from *Junkers Nachrichten*, Vol. 14, No. 3/4, pages 21–27, 1943). Some results are reported of an investigation of the effect on the human body of strong centrifugal forces. The observer's place in a Ju 87 was equipped for making X-ray observations and X-ray pictures. The subject was placed in a seat and faced the nose of the plane. The back of the seat was cut in its center part to allow an unobstructed passage of the X-rays. The examiner faced the rear of the plane. It was found that spirals could be flown so sharply that at a speed of 320 km.p.h. radial accelerations between 7 and 8 *g* became effective during more than 5 sec.

Two hundred test flights were made, and no visual disturbances could be noticed below 4 *g*. Above 6 *g*, half of the subjects, tested while sitting upright, experienced an indistinct field of visibility. At 7.5 *g* about 80 per cent of the subjects lost their vision entirely, called "black curtain." Resistance against the effect of centrifugal forces may be increased by 2 *g*, if the subject assumes a crouching position, and a further increase may be obtained by lying flat. When lying face downward it was demonstrated that 10 to 12 *g* could be endured without any bad effect, and when lying face upward even 15 *g* could be withstood for 2 min. The only effect was that breathing was rendered more difficult. These experiments proved also that, because of lack

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of oxygen when altitude sickness is about to take effect, a 3 *g* acceleration lasting 2 to 3 sec. is sufficient to cause unconsciousness. *Zeitschrift des Vereines Deutscher Ingenieure,* August 21, 1943, pages 541, 542, 2 illus.

Metallurgy

Zircon Refractories for Aluminum Melting Furnaces. R. W. Knauft. A report of operating experience in the use of zircon (zirconium silicate) refractories to improve not only hearth life and production rate but also the quality of the metal melted. Information is given on results obtained with fire-brick hearths. Advantages found in the use of zircon refractories are summarized as follows: (1) cleaner metal; (2) increased output per furnace through uninterrupted production; (3) longer hearth life; (4) lower hearth cost per ton of metal produced; and (5) versatility, such hearths being unaffected by either oxidizing or reducing atmosphere. *Metals and Alloys,* December, 1943, pages 1326–1330, 6 illus.

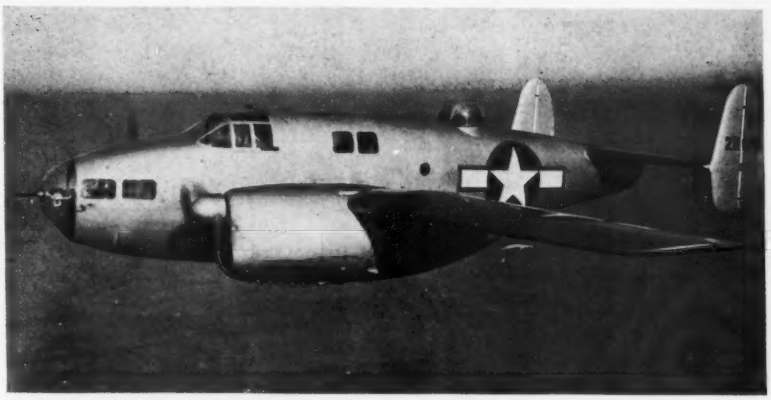
Heat Treating Wrought Aluminum Alloys. Methods of increasing the strength of aluminum alloy by heat-treating or cold-working are discussed. The properties of various alloys are outlined with reference to the service they are intended to perform. Detailed descriptions are given of the solution heat-treatment, the precipitation heat-treatment, and annealing. The article was prepared by the technical staff of the Aluminum Company of America. *Steel Processing,* December, 1943, pages 639–644, 647, 654, 17 illus.

Surface Treatments for Magnesium. Part II. Emmette R. Holman and James P. ApRoberts. The second and concluding installment of an article on surface treatments for magnesium alloys. Additional chemical processes are discussed. Plating procedures are described under sections dealing with the nickel plating and silver plating of magnesium. Organic coatings are then discussed. *Metals and Alloys,* December, 1943, pages 1331–1334, 2 illus.

Meteorology

Thunderhead! John R. Hoyt. An elementary explanation of the nature of cumulo-nimbus thunderheads . . . . showing how they can be recognized, why they should be avoided, and what the pilot must do in case it is absolutely necessary for him to fly through thunderstorms. Five major points for recognizing thunderstorms are posted and three types of storms are differentiated—the air-mass thunderstorm, the frontal thunderstorm, and the orographic thunderstorm. In summary, the characteristics of cumulo-nimbus thunderheads are marked as follows: (1) The most turbulent area lies in the lower two-thirds of the storm, especially in the roll clouds; (2) updrafts are in the roll-cloud area, while downdrafts are in the center and rear; (3) hail and lightning are found in the center chimney area and even in the outer portions, with the altitude at at which hail may be encountered lower in the winter; (4) the intensity of the storm depends upon the distance from the base of the cloud to the ice level; and (5) thunderstorms in the northern hemisphere rotate counter-clockwise. Pilots are advised to: (1) Analyze the storm and determine which type it is; try to fly around it if possible, but if it is a frontal type, to fly between the series of storms encountered. (2) Determine the direction of the storm and head in at a right angle and to hold this course above all else. (3) Go in low because of the updrafts in the roll area if ahead of the storm; go in high because of the downdrafts if behind the storm. *Flying,* January, 1944, pages, 57, 126, 132, 1 illus.

Atmospheric Turbulence. L. P. Harrison. The causes of air disturbances are analyzed in a discussion of air turbulence near the surface of the earth and of major eddies which range up to a dimension in the direction of the wind of the order of 10 to 20 miles. Points of similarity between these major eddies and those with dimensions on a scale of 4,000 ft. by 600 ft. are listed and discussed. Conditions under which each of two groups of major eddies occur are outlined. Gusts and their time variations are explained. and changes of wind velocity are shown to range up to 100 per cent of average velocity. *Soaring,* May-June, 1943, pages 9–11, 1 illus.



A recent photograph of the Fairchild "Gunner" AT-21, shown with guns mounted. This airplane, covered with plywood manufactured by the Duramold process, is in production for the Army Air Forces at the Fairchild plant in Burlington, N.C.

Military Aviation

Planning an Air Raid. Squadr. Ldr. A. C. H. Purthrey. An account of the importance of military intelligence in the planning of air raids. It is noted that the information required is of two kinds: that gathered from outside and that gathered from inside—that is, data accumulated in operational work in action. How this information is collected in Britain by the Air Ministry, studied, and forwarded to those officers whose duties it is to plan the activities of the various R.A.F. Commands is described. *Flying Aces,* February, 1944, pages 34, 35, 66, 5 illus.

Fighter Operations. Capt. Norman Macmillan. The many and varied operations demanding the employment of fighter aircraft are discussed. Because the tactical handling of fighters depends on the type of operation in which the aircraft are employed, a few operations are enumerated and the differences between them are considered. *Canadian Air Cadet,* December, 1943, pages 10, 23, 1 illus.

Formation Flying. By a Flight Officer of the Royal Australian Air Force. Patterns of flight that are designed to meet specific purposes and needs during combat operations or maneuvers are described. Echelon, V, "line astern," and box formations are among those discussed. It is noted that the types of formation most suitable for fighter aircraft are not always advantageous for bombers. The effect that plane groupings have on fire power is explained. *Flying Aces,* February, 1944, pages 39, 58, 1 illus.

Model Airplanes

Lilliput Assembly Line. A description of how a department of Consolidated Vultee is turning out model airplanes. It is explained that the models are sent to Consolidated Vultee representatives for demonstrating purposes and that Army and Navy flight instructors find them useful in preflight courses for demonstrating the theory of flight. *Aircraft Age,* February, 1944, pages 38, 39, 64, 6 illus.

Personalities

Hitler's Bemedaled Muddler. Hauptmann Hermann. An analysis of Hermann Goering's inefficiency as leader of the Luftwaffe. Although Goering is stated to have been an excellent pilot and is credited with a natural talent for leadership, his lack of knowledge, experience, and under-

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standing with regard to military strategic principles or the production of aircraft is demonstrated. It is claimed that Goering was so busy building up a fortune for himself and acquiring governmental positions that he had not time to devote to the proper development of German air power. Failure of the Luftwaffe to build heavy, long-range bombers is attributed to the psychologic fact that Goering could only interpret military aviation in terms of himself and his own fighter-squadron days. The character study includes an explanation of why Goering was chosen head of the German air force and a report that at present he is only its nominal leader. *Skyways*, January, 1944, pages 28, 29, 80, 82, 6 illus.

Four Stars and a Heart. Devon Francis. A character sketch of General Henry H. Arnold. Emphasis is placed upon the part he has played in the growth and development of the Army Air Forces. *Collier's*, December 25, 1943, pages 27, 76.

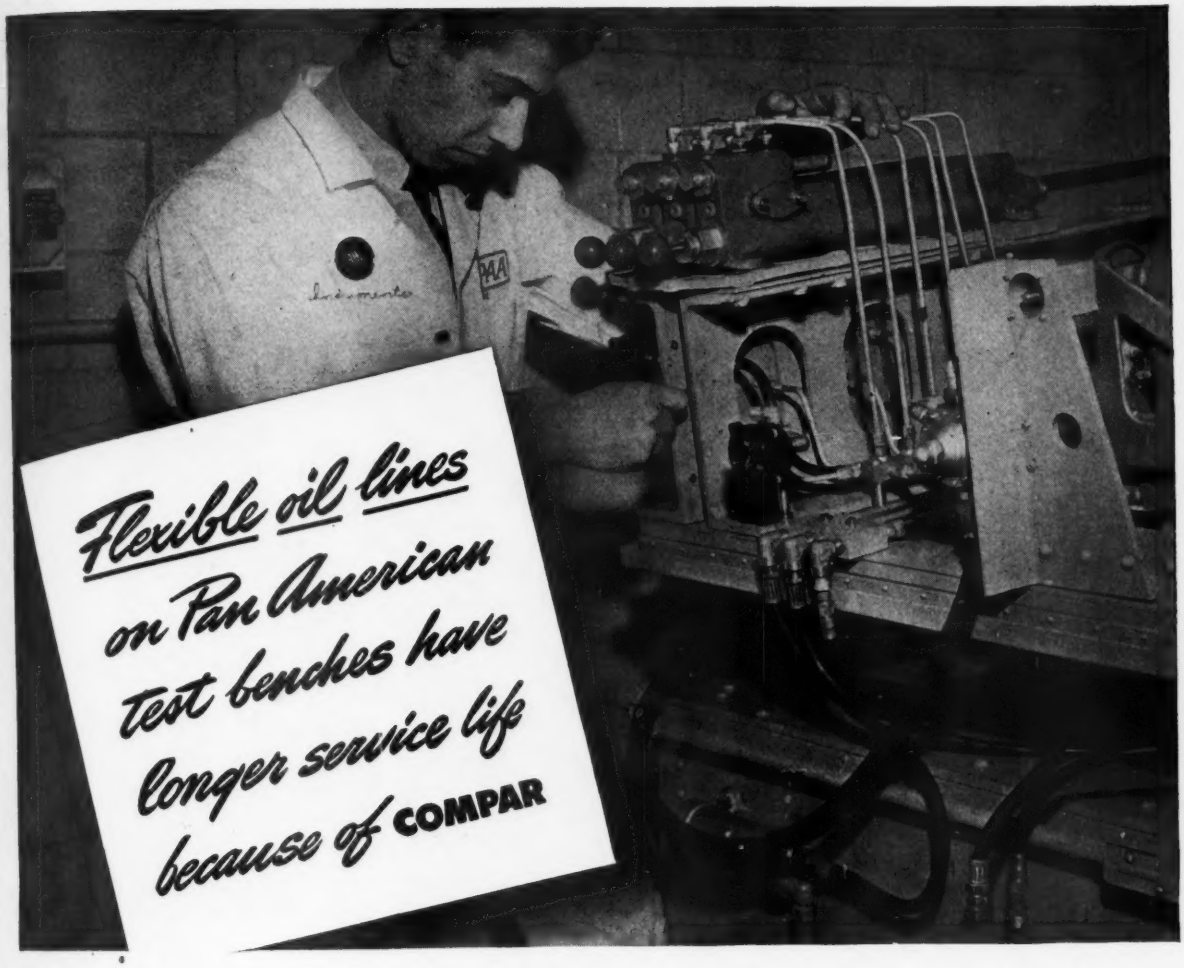
Oklahomans Fly Young. Mary Parker. A biographic article on O. M. Mosier, Vice-President of American Airlines. Mosier's activities as an Army pilot, exhibition flyer, political secretary, polo-pony trainer, baseball player, football coach, test pilot, city manager, and air-line operator are recounted. *Airlanes*, November, 1943, pages 2, 3, 27, 33, 3 illus.

Wiley Post. Keith Kahle. A eulogy on Wiley Post. Some biographic details are included, but the article is mainly devoted to a character sketch of the man. . . . all of it laudatory. *Airlanes*, November, 1943, pages 19, 28, 1 illus.

Personnel

Fostering & Maintaining Morale Among Canada's Aircraft Workers. William A. Hunter. An account of how Canada's man-power resources have been sustained through organized personnel relations planning and cooperative effort. The background, purpose, accomplishments, and working methods of the Aircraft Industry Relations Committee are considered. Formed for the purpose of improving personnel relations within the aircraft industry, this committee is composed of the chief executive officers of every important airplane company in Canada, assisted by special advisory committees, including representatives of labor from the plants concerned. The discussion touches upon: the man who heads it; the Personnel Relations Committee which preceded it; the Employees Suggestion Plan which was inaugurated; the coordination of individual personnel men inside aircraft plants; the work of educating labor to an appreciation of the national need; and the recent National Conference of Personnel Directors held under the auspices of the A.I.R.C. *Commercial Aviation*, October, 1943, pages 148, 150, 152, 2 illus.

Unskilled Labour. Part II. Following an installment on the training



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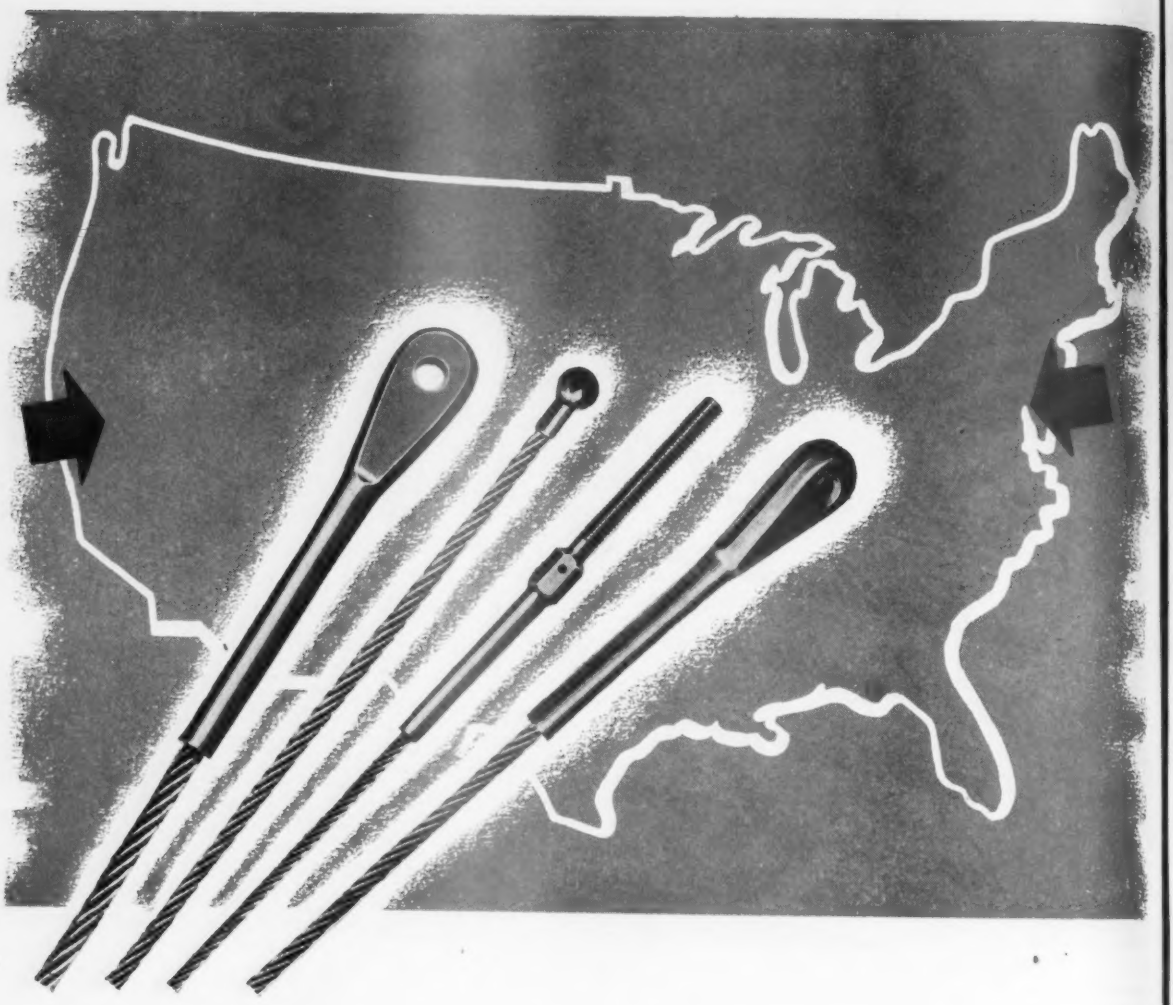

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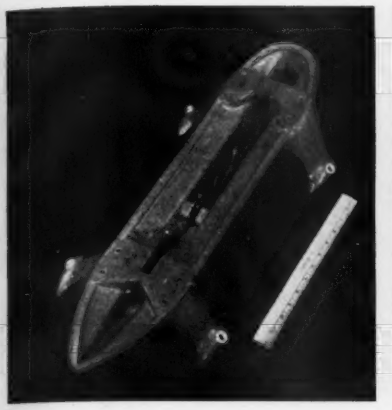
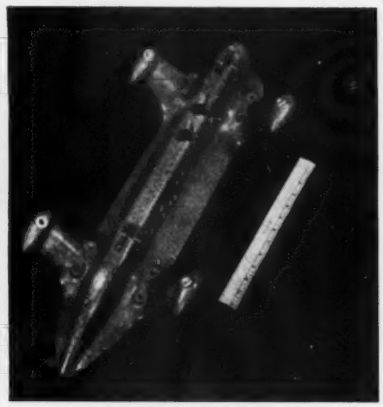




The plastic bomb rack of the Mustang. The four legs shown in this outside view of the rack are capable of supporting a 500-lb. bomb or a jettison gasoline tank

of newcomers to the aircraft industry, Part II of this article suggests various methods for increasing the productiveness of unskilled workers. It covers the contributions of such factors as the balancing of operations, methods of payment and bonus systems, and plant layout. Advice is given with regard to the scheduling of work, increasing the schedule, the breakdown of operations, and the assignment of tools and equipment. *Aircraft Production*, December, 1943, pages 595–598, 1 illus.

Plants

Precise Planning Expedites Department Shifts. Herbert Chase. Pratt & Whitney's planning procedure for changing department layouts and moving machinery and plant equipment is outlined. It is described how the shifting of equipment is diagrammed and added to a master layout made on Masonite board. The diagrams are made largely through the use of templates and photostatic equipment. *Wings*, November, 1943, pages 746–748, 5 illus.

Plastics and Plywood

New Woods for Old. John S. Trevor. Because there is still some confusion regarding the differences between various kinds of resin-treated woods, the writer attempts to clarify the situation which is stated to have been rendered somewhat obscure by the misuse of technical names. Definitions are given of the different kinds of plywood, and comparisons are made between the new woods and the metals. *Aeronautics*, December, 1943, page 56.

Relation Between Repeated Impact and Fatigue Tests. William N. Findley and Otto E. Hintz, Jr. Tests were conducted to determine the effect of repeated-blow impact loading on cellulose acetate and to evaluate this effect in terms of the fatigue properties of the material. The material and specimens used in the tests are described. Information is given on the repeated impact and fatigue machines employed in the performance of the tests. Calculations of the stress due to impact are set forth. The conclusions arrived at are listed. *Modern Plastics*, December, 1943, pages 119–123, 6 illus.

Postwar Aviation

Domestic Air Future Charted at Clinic. A report on the First National Clinic of Domestic Aviation Planning sponsored by the National Aeronautic Association and held in Oklahoma City on November 11–13. Aimed at formulating a plan for the development of domestic aviation, the conference was devoted to discussion of postwar aviation problems. At its conclusion resolutions were adopted calling for the immediate creation of one department of national defense with separate secretaries for Army, Navy, and Air; the establishment of a service pattern by the C.A.A. looking toward extension of air service to all the American people; the encouragement of aeronautical research as a vital factor in national defense; the cooperation of state and national governments in carrying out postwar aviation programs; the continuance of training and aeronautical programs for the creation of an air reserve; disposal of surplus military aircraft through an appropriate Government agency; uniform procedures and accounting practices in termination of contracts, including the provisions that profits be figured after taxes and that 90 per cent of contractors' claims be paid in advance; and private enterprise, under reasonable regulation, as an essential factor in the development of aviation.

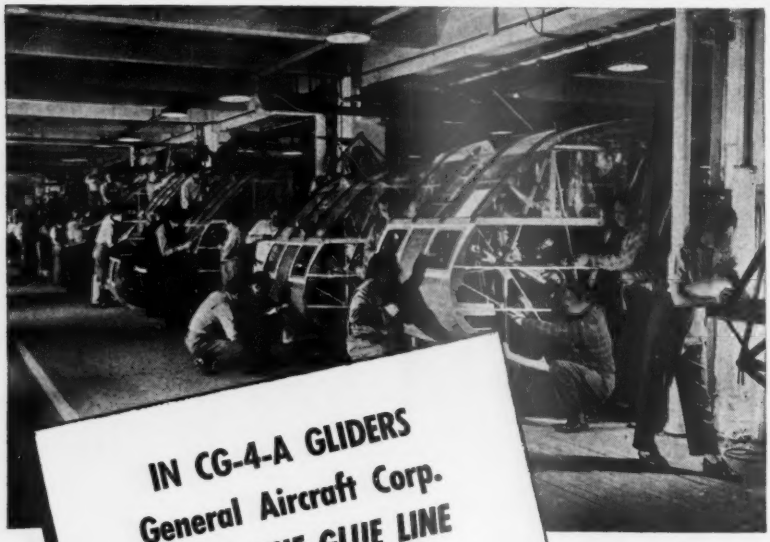
Among the problems dealt with at the meeting which are stressed in the report are the necessity for immediate planning, the danger of aviation being "oversold," and the Lea bill. Excerpts from speeches made by the following are reviewed: Harllee Branch, William A. M. Burden, C. Edward Leasure, Joseph T. Geuting, Jr., and Gill Robb Wilson. Other speakers and their subjects are listed. *Western Flying*, December, 1943, pages 56, 58, 122, 124, 1 illus.; "The First National Clinic," *National Aeronautics*, December, 1943, pages 16–46, 27 illus.; "Clinic Sets Pace for Aviation Planning," George E. Haddaway, *Southern Flight*, December, 1943, pages 36, 37, 56, 58, 64, 1 illus.

The Future of Aviation. Ralph S. Damon. Probable advances in aviation up to the year 1953 are discussed. It is stated that if it is possible to break through the speed of sound for regular aircraft operation, it will probably be with the supercharged, flying-wing, "squirt-type" plane. Other specific technical prophecies are made. The writer presents his views on the future of the helicopter, private flying, transport aircraft, fuels of the future, and other items. *S.A.E. Journal*, January, 1944, pages 17–19, 39, 1 illus.

Let's Be Practical About Postwar Plane Markets. E. E. Lothrop. A quantitative analysis of probable postwar markets for American aircraft in which it is concluded that, while the aviation industry will be considerably larger than it was before the war, airplane requirements will fall far short of maintaining it as the world's premier industry. Indicating the types of planes that will be used, the study appraises two markets: The first, identified as V-2, covers a period of 2 years after the cessation of hostilities (including those with Japan) and embodies the climax of the transition period; the second, called V-5, covers the 5 years after final victory.

Summarized, the V-2 market is expected to consist of 20,500 military air force planes which, with spares, will cost $2,785,400,000; yearly replacements of these planes amounting to 6,000; 1,700 air transport planes which, together with spares, will cost $512,500,000; and 9,500 civil planes costing $71,750,000. The V-5 market summary is projected as 2,925 air-transport planes, with spares, valued at $618,000,000; 2,875 cargo planes, with spares, valued at $780,000,000; and military replacements of 6,000 aircraft annually. Because of uncertainty with regard to design and production changes, personal plane requirements for the latter period are not estimated. All market classifications are broken down into specific divisions in the article. *Aviation*, December, 1943, pages, 114, 115, 351, 353, 355, 357, 358, 2 illus.

Postwar Airways. III. Allen Scott. In the third of a series of articles on airways of the future, the writer continues a discussion of radio-frequency communications planning. It is stated that the availability of much medium-frequency apparatus indicates that its use will be continued after the war. It is believed that there will not be suffi-



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cient ultra-high-frequency equipment available for an immediate change to that type of communication. Problems of aircraft communication are reviewed, and the services of a nonprofit organization operated in the interest of all the air lines are outlined. *Air Transport*, December, 1943, pages 51, 52, 54.

Shipowners' Plan to Operate Air Lines. A British shipowner's views on postwar air transport are interpreted. Arguments advanced in support of the belief that shipping companies should be permitted to operate air lines include the following: (1) Administrative and documentary work per unit of traffic is much the same for either sea or air transport and can be carried on within the framework of existing organizations without additional expenses; (2) shipping companies possess the premises, staffs, and experience for dealing with local customs and conditions in the case of overseas agencies; and (3) foreign countries will prefer to grant airspace to private companies whose use of their ports are established rather than enter into political agreements between governments. Plans with regard to the acquiring of equipment and experienced air operatives, routes, and agreements are also touched upon. *The Aeroplane*, November 5, 1943, page 534, 1 illus.

The Case for the Established Air Lines. Following an article in which a shipowner's views on why they should be permitted to operate air lines were published, this article presents arguments why postwar air transport should be confined to operation by experienced and established air lines. Not only are inadequacies of British shipping companies and railways in the conduct of their own businesses pointed out, but an analysis of four statements by surface transport operators is offered to show that their understanding of air transport problems and their ability to handle such are thoroughly incomplete. Included in the comments are observations with regard to air-line subsidies; operating costs of air services; staff and facility requirements for inland offices; and the differences between transit speeds, limited pay loads, international formalities for schedule preparation, fleet application, food catering, and provision for night stops. *The Aeroplane*, November 12, 1943, page 559.

Let's Clear the Air! W. H. Coverdale. The planning and preparation for postwar air transport activities are discussed, as well as postwar expansion, monopoly versus competition, and the position of the American Export Airlines, Inc. *Airlanes*, December, 1943, pages 5, 18, 1 illus.

How the Industry Views the Future. A compendium of statements by leaders of the aircraft industry expressing their views on the future of aviation. Statements are made by A. N. Kemp, Dwane Wallace, Harry Woodhead, Donald W. Douglas, C. E. Foulk, A. Kartveli, W. A. Patterson, T. Claude Ryan, J. Carlton Ward, Jr., James C.

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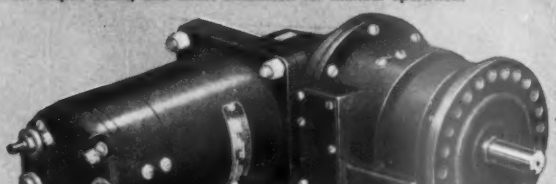

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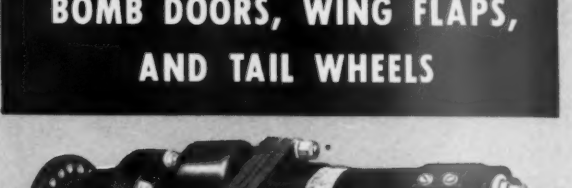

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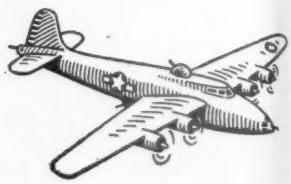

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Progressive Spirit Cannot Be Measured with a Slide Rule. C. P. Graddick. A discussion of the future development and prospects of air-cargo transportation. Consideration is given to how a great air-cargo system can be developed without hurting the railroads. It is stated that, in addition to air transport expansion in the United States, there will be an expansion of world air routes and that the planes of the future will permit further reductions in rates. The helicopter will find its place in the picture, perhaps in the feeder or taxi type of service. *Air Transportation*, December, 1943, pages 37–39, 2 illus.

Switzerland Looks Ahead, Visions Airline to United States, Airport for Overseas Transport. Henry Pillichody. The Special Representative of the Swiss National Office of Transportation reviews Switzerland's past activities in the field of air transport, describes a projected airport for overseas transportation, and discusses postwar plans, including those for United States–Swiss trade. He states that Switzerland would favor a nonstop air-line connection to the United States and points out the advantages of such an air line. Figures are given on past passenger, cargo, and mail traffic, and estimates are made for future air commerce. *Air Transportation*, December, 1943, pages 5–10, 4 illus.

The Present Position and Future Policy. Major K. M. Beaumont. Based upon opinions expressed by experts in the United States and the United Kingdom, conclusions with regard to the future of international air transport are summarized. In addition, the writer suggests a future policy for Britain to follow and outlines the main points of this policy. The conclusions deal with freedom of the air, nationalization versus private enterprise, internationalization, and subsidies. The suggested plan covers eleven major points that depend in part upon the creation of an Aerial Board of Control and Ministry of Air Transport. *The Aeroplane*, November 19, 1943, pages 586, 587, 1 illus.

Essential Points in Postwar Aviation. T. Claude Ryan. Depicting the essential importance of a thriving aviation industry to the postwar economic prosperity and national security of the United States, the president of the Ryan Aeronautical Company discusses the future position of aviation and suggests certain Governmental policies with regard to its development. He advocates Government assistance in the establishment of a far-flung, privately operated, international air transport system and in the expansion of the domestic air-line system to give complete coverage of the nation, with feeder and local routes supplementing major trunk-line service. He urges that privately owned aircraft be given the benefit of reasonably prosperous economic conditions together with Government sponsorship and supports the idea that an adequate standing air force be maintained. If air-line development, private ownership, and other commercial utilization take place in accordance with the country's potential capabilities, the writer reasons that a sound and steady expansion of aircraft manufacturing will also result.

Two other questions are covered: that of Government-owned airplanes that will be left over when the war ends and Government-built aircraft factories owned by the Defense Plant Corporation. The opinion is offered that the factories should be used primarily as Government warehouses for the storage of the warplanes and as reserve facilities in case of future threat of war. It is also suggested that provision be made so that portions of these war-built plants could be purchased or leased by aircraft companies as they need them. *Western Flying*, December, 1943, pages 66, 68, 132, 134, 3 illus.

Aerial Survey of Canada Immediate Postwar Need. Frank Flaherty. A delineation of one of the first big jobs facing Canadian airmen after the war. The completion of a basic aerial photographic survey of Canada is indicated as essential to the full exploitation of Canadian resources and, consequently, to the provision of full employment in the postwar period. In addition to disclosing untapped mineral, forest, agricultural, hydroelectric, and game and fish resources, accurate aerial maps and photographs are deemed necessary for planning water conservation and power development projects; in settling routes for roads, railways, airways, telegraph, telephone, and power lines; and in the conservation of game and fur-bearing animals. Reviewing the portions of Canada which have already been surveyed, the article also notes the equipment, facilities, and personnel that will be available for the future work. *Canadian Aviation*, November, 1943, pages 52, 53, 134, 4 illus.

Production

Stretch Forming of Sheet Metal. T. S. Clark and C. L. Fenn. The two greatest advantages of the process of forming sheet metal over form blocks by stretching are stated to be the economy and speed with which the die blocks can be made and the basic versatility of the hydraulic stretch press itself, which permits operations over a wide range of dimensions. Other advantages are found in the accuracy of reproduction, enabling the manufacturer to be sure of the fitting and interchangeability of parts, and in the low initial equipment cost. A new technique known as "longitudinal stretching" is described. A double-fluted bottom sheet for a seaplane float is cited as an example of the work that can easily be done on a longitudinal machine, and the method is explained at length in connection with the forming of this and other aircraft parts.

It is stated that, in addition to aluminum, stainless steel is one of the most satisfactory materials to stretch, particularly in the annealed state. Instructions are given for adjusting the jaws of the machine in case equipment designed to work on aluminum sheet fails to hold the steel sheet. Studies to determine whether or not a part can be formed by stretching are discussed in detail, and the results are tabulated and charted. It is stated that the process can be applied to numerous other industries in addition to aircraft and that a widely extended field of utility may be expected for this method of metal forming. *Aero Digest*, December, 1943, pages 154–158, 250, 254, 264, 266, 17 illus.

Reduction of Assembly Time. B. C. Boulton and H. N. Harrison. Realizing the time lost in parts fabrication and assembly operations through minor inaccuracies in engineering drawings reproduced in, or augmented by, tooling, the Advisory Committee for Engineering of the West Coast War Production Council created a pool of information on the subject of dimensional integrity. Each company prepared a report for the Council giving methods that its organization had adopted to assure maintenance of dimensional integrity from the conception of the engineer to the finished part or assembly. This article contains the essentials of the report made by Lockheed. *Automotive and Aviation Industries*, December 1, 1943, pages 34–37, 69, 70, 7 illus.

Simple Methods Mass-Produce Transport Tanks. Henry E. Guerin. Numerous photographs supplement details on tank-fabrication and assembly methods employed by Douglas Aircraft Company, Inc. It is described how the varied fuel and oil containers for the military versions of DC-3 transports are turned out by means of a flexible production setup that utilizes only one steel fixture, one dolly, and one hoist. As broken down by the company's production engineers, the main fuel tanks consist of two overlapping skin section halves, two ends, six longitudinal and eleven radius stiffening angles, and eleven baffles. These are fabricated in the drop-hammer and hydropress departments and come to the tank assembly department with rivet holes drilled, stiffening "pillows" formed, and most of the forming already done. *Wings*, November, 1943, pages 741–745, 16 illus.

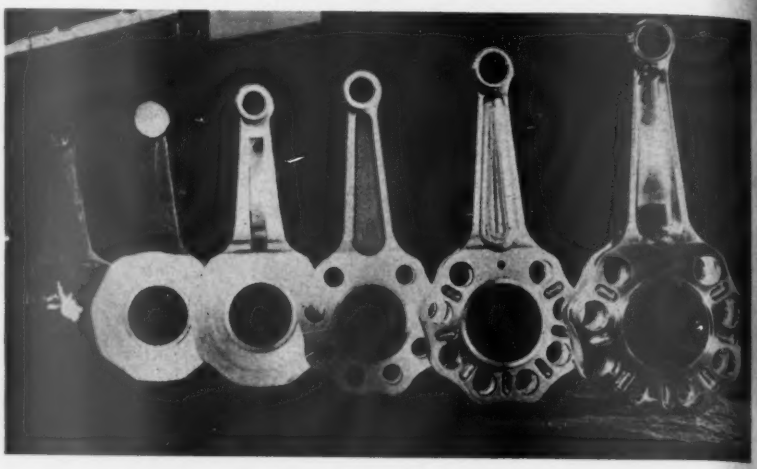
Equipment Assembly. Application of the subassembly principle is illustrated by details on the production methods employed for several Airspeed

Oxford components. Advantages of having trained crews perform the same operation on every component and spreading the work simultaneously over the greatest possible number of operatives are indicated. The first part of the article deals with the fuselage flooring unit assembly; the second deals with the completion of equipment installation in the subassembly stage, as effected by means of the special electrical test rig for inspecting the electrical and hydraulic circuits on the center section of the Oxford fuselage. Testing operations are outlined in their sequence from starboard to port. *Aircraft Production*, December, 1943, pages 575–578, 8 illus.

Aviation's "Explosion." Mac Short. The writer—President of the Society of Automotive Engineers—discusses the transition of the aircraft industry from "building" airplanes to "manufacturing" them. Interpreting the difference between the two terms, he indicates some of the problems of engineering, design, tooling, and shop procedure which were involved in the changeover. He also explains why he believes "mass production" is a misnomer when applied to airplane production . . . . pointing out the relatively small number of units required for the relatively large number of components and the constant changes in design, production, and engineering which are required. His observations include the remark that he does not think airplanes will be manufactured cheaply after the war. He also calls attention to the fact that if the industry cannot produce planes cheaply neither can the automobile manufacturers, since the two groups are working on the manufacturing problem together, with the same approaches, the same selection of workers, and the same tooling. *Southern Flight*, December, 1943, pages 40, 41, 60, 2 illus.

Stabilized Quality Control. H. Howell. After briefly reviewing the advantages and limitations of existing quality-control systems, the writer urges that the subject be approached as a check on production processes more particularly than as a check on the product. A practical example is worked out, assuming an assignment of stepping, drilling, and tapping at each end a lot of bright mild-steel bars according to specified tolerances. Referring to tabulated data, alternative methods of calculation are explained for establishing the tolerances and analyzing the causes of defective work. Economies in time, records, and decisions are said to be possible through the use of the method advocated. A step-by-step routine is suggested, with detailed instructions for keeping the necessary records. *Aircraft Production*, December, 1943, pages 579–584, 3 illus.

Photographic Templates. E. C. Jewett and C. D. Tate. This is the first of a series of articles discussing the transposition of design information from the drawings to the metal machine part or to the templates to be used in the manufacture of the part. It is noted that there are many problems connected with carrying out this work under conditions of large-scale production. Both photographic and nonphotographic methods are considered. Sections of the article discuss photocopying directly on the templates, the requirements for reproducing drawings, projection methods, contact methods, the use of the x-ray contact method, and the preparation of photosensitized material. *The Draftsman*, December, 1943, pages 10, 34, 40, 41.



The evolution of a master connecting rod of a Pratt & Whitney engine is shown in this series of rods in rocess of manufacture.

Reclamation and Production Are Partners. Gordon C. Sleeper. A description is given of the organization and operation of the reclaiming department at the Farmingdale plant of Republic Aviation. Information is given on the scrap sales division, hardware sorting division, and surplus sales division. Special machinery devised to facilitate reclamation work is described and illustrated. *Wings*, December, 1943, pages 788–790, 8 illus.

Canada's Aircraft Production 1939–43. William A. Hunter. A summary of Canadian aircraft production from 1939 to 1943, in which Canada's important contribution to the war effort through the building of training planes for the Commonwealth Air Training Plan is stressed. Starting with the problems that had to be faced and the rapid organization that was necessary for the Dominion to begin producing war planes, the writer briefly traces the planning and production progress of 4 years. He names the various companies that have participated in the program, reports the types of aircraft which have been built, and describes the role of Ralph P. Bell in helping Canada to become an effective aircraft-manufacturing force. In addition to expenditures, figures are quoted on the number of people employed by the industry, the number of aircraft produced (together with proportionate ratios of types), and the amount of space occupied by airplane manufacturing and overhaul plants. *Commercial Aviation*, November, 1943, pages 48–52, 54, 19 illus.

Plane Production Illustration. Oliver J. Chayie and George Tharratt. This article discusses what is called the "fifth phase" of production illustration as developed at the Adel Precision Products Corporation and applied to the manufacture of precision parts for aircraft. It is written specifically to show what can be done with a production illustration program when dealing with the precision manufacture of a single small important component of an airplane.

The four basic phases are defined as: (1) development of the original perspective, the production breakdown, and the loft breakdown; (2) structural unit illustrations and functional (system) illustrations; (3) development of job and subassembly illustrations for the production line; and (4) drawing changes. It is stated that these first four phases were developed in connection with the production of large and complicated structures such as ships, tanks, and complete airplanes, and that the fifth phase is needed for the adaptation of the process to the manufacture of small precision parts.

As an example of such a part, a unit known as "quad" is taken; this is a four-directional control valve used to direct hydraulic fluid under pressure to the cowl-flap actuating cylinders. The factors affecting the application of production illustration methods to such a small part, involving close tolerances and fine finishes, are explained at length, covering a study of specific shop conditions, particular requirements of the part, inspection procedure, assembly of components, and testing the finished part. Other points covered include the transmission of instructions by illustrations instead of by printed matter; systems for routing drawings to all interested personnel; and plans for numbering, issuing, and filing illustrations. Advice is given on establishing the routine for a production illustration department. *Aero Digest*, December, 1943, pages 224, 226, 229, 278, 280, 7 illus.

The Guy on the Ground Crew

Sure, the guy who stays on the ground wins battles in the sky.

He works at an improvised airfield many miles from nowhere. He services battle-scarred planes to fly and fight again. He, *literally*, keeps 'em flying!

The skill of our aviation mechanic is one military asset the Axis can't copy. It's partly the product of a superb training program. Partly, a mechanical knack for making things work.

We like to think that there's something of this typically American genius in the way men and women of Bell Aircraft build the U. S. Army Airacobra. They started with the idea of a "cannon on wings." To make this idea work, they designed a swift, single engine, cannon bearing fighter. They're building 'em—fast!

They ask no higher praise than to be considered team-mates of the guy on the ground crew

File this thought away for postwar reference. The men and women of Bell Aircraft will be ready for their assignments . . . ready with a war born habit of *thinking* new planes, techniques for designing, engineering and building them, a knack for making them work. © Bell Aircraft Corporation, Buffalo and Niagara Falls, New York.

MEMBER AIRCRAFT WAR PRODUCTION COUNCIL—EAST COAST, INC.

BELL *AIRCRAFT*

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PACEMAKER OF AVIATION PROGRESS

BUY WAR BONDS AND SPEED VICTORY

THAT OUR COUNTRY MIGHT *Take Wing* AGAINST THE ENEMY

Curtiss-Wright built FIRST and MOST . . . Flying 20 seconds apart, Curtiss Fighters would encircle the globe!

☆ FIRST and MOST—a sensational claim—yet not to be disputed! Curtiss radial engine Hawks for France and Mohawks for England in 1939! Curtiss in-line engine Tomahawks in Libya and China in 1940 and 1941! The higher performance Curtiss Kittyhawks in global warfare in 1942 and in 1943 and 1944 an even more powerful fighter—the Curtiss Warhawk.

☆ The FIRST German plane fell victim to a Curtiss Fighter over France—the first Jap plane over Pearl Harbor! In fifty authenticated aerial engagements Curtiss Fighters ran up a bag of 13½ enemy planes for each Curtiss Fighter lost.

MEMBER, AIRCRAFT WAR PRODUCTION COUNCIL, EAST COAST, INC.

☆ MOST, by far! If all Curtiss Fighters built since hell broke loose throughout this world could take off at top speed from one huge base, they would form a deadly circle of flying might 25,000 miles in circumference —a tornado of power and a living symbol of American aerial supremacy that would encircle the globe.

Another Contribution of

Curtiss-Wright Corporation

AIRPLANE DIVISION

Toward Winning This War

BUFFALO • COLUMBUS • ST. LOUIS • LOUISVILLE

IRC WILL BE READY

with PRECISION WIRE WOUND RESISTORS

WHEN IT'S OVER "OVER THERE"

IRC will be in a specially favorable position to supply *all types* of Resistance units—of high Quality—in large Quantity—at low costs made possible by mass production.

FIRST IN WAR . . . FIRST IN PEACE

Produced by the most modern and efficient manufacturing methods, tested and perfected to meet the exacting demands of war, IRC Resistors will maintain their leadership as first choice of electronic engineers, manufacturers and service industries of tomorrow. . . . You are invited to consult our engineering-research staff now, in confidence, on any resistance problems connected with your peacetime products.

CHECK THESE FEATURES OF IRC PRECISION WIRE WOUND RESISTORS

1. *Most rigid specifications on enameled wire.*
2. *Largest size wire used for each resistance value and size.*
3. *Steatite ceramic (with baked impregnation to prevent moisture absorption and to protect enameled wire from surface abrasions).*
4. *Specially designed winding machines eliminate stress and strain, avert damage to insulation and minimize fatigue of wire.*
5. *Baked impregnation of winding insures that wires remain rigidly in place and that resistors are independent of temperature variations.*

PREFERRED FOR PERFORMANCE
IRC
FIXED & VARIABLE RESISTORS

INTERNATIONAL RESISTANCE CO.

401 N. Broad St. Philadelphia 8, Pa.

IRC makes more types of resistance units, in more shapes, for more applications than any other manufacturer in the world.

WHEN YOU PLAN YOUR POST-WAR PRODUCTS

take advantage of these features of

ELECTRUNITE TUBING

1 **UNIFORM DIAMETER** —both O.D. and I.D.

2 **UNIFORM WALL THICKNESS** —at every point in the wall**

3 **UNIFORM CONCENTRICITY** —from end to end of every length of tube

4 **UNIFORM STRENGTH** —throughout the entire tube structure (the weld is as strong as the wall)

5 **UNIFORM DUCTILITY** —means greater workability

6 **UNIFORM WEIGHT** —assures dynamic balance in finished product

7 **SMOOTH, SCALE-FREE SURFACE** —free from laps, slivers, rolled-in scale and other injurious defects

8 **UNIFORM WELDABILITY** —no allowance for uneven wall thickness is necessary

9 **UNIFORM WORKABILITY** —physical properties are constant**

10 **FREEDOM FROM HIDDEN DEFECTS** —both surfaces of the flat-rolled steel are inspected

***Be sure to consider both "as welded" and "flash-removed" grades, as well as annealed and unannealed, in your plans. Write for complete detailed information.*

REPUBLIC STEEL CORPORATION, STEEL AND TUBES DIVISION, IS THE ONLY PRODUCER OF ELECTRUNITE TUBING.

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REPUBLIC STEEL — PRODUCTION FOR VICTORY

MECHANICAL, AIRCRAFT AND PRESSURE TUBING IN CARBON, ALLOY AND ENDURO* STAINLESS STEELS

An Approach to the Problem of Aircraft Production: R. R. Foster. An analysis is given of the application of production management methods to the aircraft-manufacturing industry. Beginning with the premise that the factory must be organized around the product, and that the first step is a thorough study of the product, a program is laid out step by step for the organization of such specialized functions as engineering, tooling, materials, planning, scheduling and control, and manufacturing. Component units of the various main departments are fitted into the plan and their work is outlined.

A new concept of production control is offered as a fairly accurate yardstick for measuring performance and evaluating results. A summary is given of the organization of assembly or installation work stations, and an example is tabulated. *Western Flying*, December, 1943, pages 96, 98.

Shaping Metal Airframe Parts. The sheet metal forming department of a de Havilland factory in England is described. Except for the blanks that are routed to profile in another shop, the department is self-contained for shaping components by the drop-stamping, rubber-pressing, and stretch-pressing processes. In addition, it includes a foundry for the production of the necessary tools and a refrigeration plant for storing blanks after normalizing.

Particulars are given on the pattern shop and tools, furnace section, tool-casting technique, drop hammers, nacelle fairing stiffener, press layout, Shaw rubber press, loading arrangements, stretch-pressing equipment, and operation of the equipment. *Aircraft Production*, December, 1943, pages 566–571, 17 illus.

Propellers

Blade Section Variation on Small-Scale Rotors. Kenneth Razak. A technique for small-scale rotor testing incorporating the use of a three-component balance, torque measurements, and stroboscopic speed measurement is described. Fifteen rotors using a related series of airfoil sections were tested. On the basis of maximum L/D, the optimum thickness ratio and the optimum camber were found to be 12 and 2 per cent, respectively. The small-scale rotors proved to be extremely sensitive to a change in both thickness and camber. Pointed or sharp-nosed sections are undesirable. It was determined that the position of maximum camber greatly influenced rotor characteristics. The center of pressure travel before and after the stall point is reflected in the pitching moments of rotors with the horizontal hinge at the axis of rotation. *Journal of the Aeronautical Sciences*, January, 1944, pages 83–87, 90, 6 illus.

Airscrew Blade Stress Due to Periodic Displacement. Translated by G. M. W. Knott. This is a report of the German Aircraft Research Station E. V. Berlin-Adlershof Institute for Driving Mechanism, taken from *Luftfahrtforschung*, Vol. 18, November 20, 1941. Various airscrew vibrational stresses are treated, as well as the possibility of their elimination by means of elastic connection of screw and engine. A measure is discussed which might protect the screw against tipping motions and consequently against the alternating centrifugal moments. The corresponding vibration equations are given, and the dimensions of the springing to be adopted are decided upon. *The Journal of The Royal Aeronautical Society*, November, 1943, pages 390–396, 3 illus.

Propellers for Canada's Aircraft. Supplemented by information on the company's development, propeller-manufacturing methods of S. & S. Aircraft, Ltd. are outlined. In relating the sequence of operations, attention is drawn particularly to those concerning edge jointing, tamping, and boring. It is reported that all propellers manufactured by S. & S. Aircraft are of the firm's own design and that part of its facilities are devoted to the reconditioning of used and damaged propellers.

In addition to a list of the executive personnel, the article also includes brief data on a new method of processing glue for the manufacture of laminated plywood, which is being tested by the Dominion of Canada at the S. & S. Aircraft plant. After laboratory tests, the new glue is claimed to effect a reduction of time in the presses from 25 hours to 5 or 10 min. *Commercial Aviation*, October, 1943, pages 48, 50, 54, 68, 18 illus.

Radio

Radiolocation—Best Kept Secret of the War. This brief commentary on radiolocation credits Sir Robert Watson with having invented radar in 1935. In proof of this contention it is stated that the United States did not have radar at Pearl Harbor. The employment of women in the operation of the British radiolocation system is highlighted. *Canadian Aviation*, December, 1943, pages 76, 77, 5 illus.

This large four-bladed Curtiss electric warplane propeller weighs in excess of 600 lbs. and measures 15 ft., 2 in. from tip to tip. It is of the full-feathering type, built around Curtiss-Wright's principle of electric control at the hub. Its blades are of hollow steel.

— then he said to himself

"TIME DOES NOT WAIT"

"THE foe cannot be beaten," says Joseph Stalin, "if his forces of today, fully developed to the utmost, are opposed by forces of tomorrow . . . TIME DOES NOT WAIT."

So, by having recourse to the forces of tomorrow TODAY . . . he makes NEWS . . . he achieves TRIUMPHS . . . he dictates HISTORY.

"Developing tomorrow's force TODAY" can well be the motto hanging in every conference room where factory committees are discussing postwar procedures.

And under that motto these words: "Our ship, tank, plane, weapon industries are TODAY working with tomorrow's greatest forces for production. Come re-conversion to peacetime products, they are in practiced strategy to outproduce and underprice all competitors who have the temerity to go into postwar production with day-before-yesterday's techniques."

"Even if you had the time—don't wait for time."

"TIME DOES NOT WAIT"... *he says*

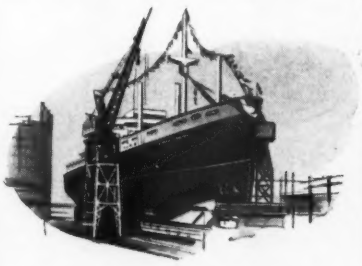
Look, Mr. Stalin, how through *recourse to Arc Welding* you can tweak time's forelock.

Similar time savings gave you tomorrow's force today.

Arc Welding, of course, will not win the war for you . . . but lack of Arc Welding could have lost it for you.

And that thought might well be another motto for each postwar planning room.

DAYS instead of MONTHS



Easily the margin between Victory and defeat—for you and the United Nations—is putting ships on the water *6 times faster*.

LAST WAR "Liberty" size ship 300 DAYS
THIS WAR they average under 50 DAYS

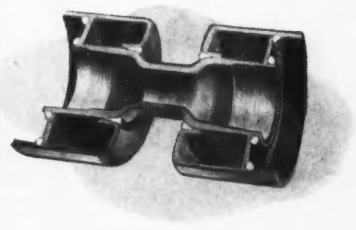
Recourse to Arc Welding in 2 years has put to work 2000 more ships than possible under old standards—thus saving the necks that Old Methods would have lost—yours and ours.

Think *that* one over!

HOURS instead of WEEKS

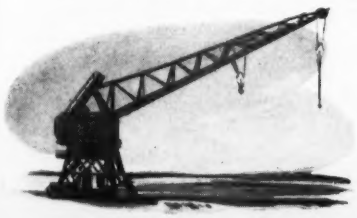
A sit-down in a steel plant lasting for weeks would be a headline SCREAM in Pravda and every newspaper in the world. That catastrophe was averted by *recourse* to Arc Welding when these six welders repaired the break of a vital steel mill part in 8 hours. Replacement would have taken weeks . . . thus sabotaging the output of a hundred war producers. Think that one over too—in terms of providing *recourse* to help in trouble.

MINUTES instead of HOURS



Half-track parts at half-time speed . . . these are typical of machine parts which *recourse* to Arc Welding helped rush to first and second fronts. Processing cost cut from $11.00 to $6.64. Machining cost cut from $3.50 to $1.25. Weight cut from 27½ to 24 lbs. Time cut 45%. This cutaway picture is to help you think over what *recourse* to Arc Welding will do to the cost of any part of any of your machines.

MINUTE-MEN of production cut MAN-HOURS on every job



This 28-ton revolving crane which literally gives the *lift* to America's ultra-speedy shipbuilding industry—gets to the job 1,584 MAN-HOURS SOONER through *recourse* to Arc Welding.

FABRICATED . . . 23.5% FASTER
ERECTED . . . . . 21% QUICKER
than by riveted construction.

THE LINCOLN ELECTRIC COMPANY • Cleveland 1, Ohio

America's greatest natural **recourse**

ARC WELDING

HOW AIRCRAFT STEEL HAS INCREASED *FASTENING STRENGTH*

Prior to the war, 1035 steel was considered about top-notch quality for a bolt—the standard for automotive use. Some bolts and cap screws were made of 2330 (high nickel steel) or 3135 (chrome nickel steel) but these were regarded as high priced specialties.

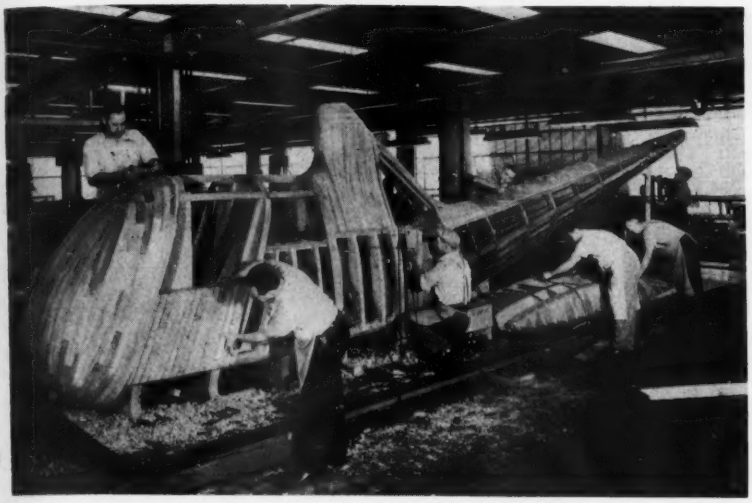
War needs for aircraft required better fastenings in huge quantities, and scarcity of alloys forced the use of newly developed "emergency" steels, particularly 4037.

This steel has been amazingly successful, both in performance and in its qualities for fabrication into tough fastenings. It gives physicals at least equivalent to those found in more expensive, harder working, higher alloy steels.

As shown above, 4037 is much stronger than 1035 steel, but it is not a great deal more expensive. It means better postwar fastenings in automotive and many other important applications.

National
HEADED AND THREADED
PRODUCTS

THE NATIONAL SCREW & MFG. CO., CLEVELAND 4, O.



A mahogany mock-up of the Sikorsky helicopter at the Nash-Kelvinator plant. From this wooden dummy will be made the jigs, fixtures, and design tools needed to produce the helicopter in quantity.

Rotating Wing Aircraft

What Is the Helicopter's True Commercial Future? Agnew E. Larsen and Joseph S. Pecker. Warning that publicity about the helicopter is far ahead of the helicopter's practical development, the writers indicate several engineering problems that must be solved before this type of aircraft will be ready for popular use by the general public. They credit the men responsible for elements of helicopter development already perfected and list seven qualities necessary for investing the helicopter with safety requirements enabling the average automobile driver to pilot it with ease. They then go on to outline nine vital factors that in their opinion should influence helicopter design. These are: (1) The single rotor, for lift, has been clearly indicated as a correct form, compared with the many multirotor designs such as those of Breguet (coaxial) or Focke-Wulf (biaxial). (2) A relatively large sustaining rotor, such as the autogiro, will continue to have marked advantages. (3) Some simple form of antitorque correction, such as the small, vertical plane propeller used by Sikorsky, will prevail for some time to come. Because of the dimensional limitation of that form, several variants will be offered. (4) Improved mechanical design of the power plant, the transmission of power to the rotor, and the rotor hub itself are essential now, in view of the present available art. (5) Inherent stability of the self-flying ("hands-off" control type) is wholly lacking in the helicopters flying today. This marks a need for major improvement. The "hands-off" stability of the autogiro is attainable in the helicopter and, in the light of extensive experience, should be applied. (6) A high degree of control is achieved in most of the helicopters flying today, as was the case in the Focke helicopter flown in Germany before the war. Much of this control stems from the successful development of direct control of the autogiro here and abroad. In fact, the mechanism of the helicopter controls, in some cases, is not so advanced, requiring further refinement. (7) Vibration characteristics of the rotor remain the most complicated single problems in advancement of the art of all forms of rotating-wing aircraft. Current helicopter successes are marred by repetition of resonant vibratory phenomena that must ultimately be solved for public use of these vehicles. (8) The actual utility of rotating wing aircraft has been studied assiduously and carried out into engineering reality in many of the later designs of autogiros and helicopters. (9) The long, unbroken record of the autogiro testifies to the practical realization of safety as achieved and attainable. This inherent safety of the autogiro must be equaled by any helicopter if it is to continue to enjoy the present public acceptance. This fact dictates a relatively large sustaining rotor for light unit loading in order that the craft may settle and land slowly enough to avoid catastrophe.

Conceptions of future helicopter models illustrate the article. One shows a possible three-place "coupe," another a multiplace type embodying controls of much greater simplicity than are currently available, and the third a proposed three-place helicopter with fixed landing gear. *Aviation*, December, 1943, pages 116, 117, 328, 331, 332, 335, 3 illus.

Don't Believe All You See and Hear About Helicopters; Look at the Bedrock Facts. Grover Loening. The Chairman of the Helicopter Committee of the National Advisory Committee for Aeronautics discusses the future of the helicopter. He calls attention to exaggerated statements made about the helicopter and states that the true picture today is that the helicopter for the next few years is limited to usage by professional aviators and professional aviation companies and is not at all a vehicle to be placed in the hands of the public. It is pointed out that the future of the helicopter is too bright to be spoiled by exaggerated statements. Reference is made to the ambitious program of research being carried out to make sure that no stone is left unturned in exploring the fundamentals of the helicopter problem.

To reveal the general principles involved in the helicopter's operation, its structural features are examined. Sections of the article discuss the helicopter versus the autogiro, the speed limitations of the present helicopter, and the future outlook for the helicopter. *Air Transportation*, December, 1943, pages 12–16, 2 illus.

Looking Ahead with the Helicopter. David J. Little. Ideas on possible future development in the design and use of the helicopter are outlined. It is predicted that larger and speedier helicopters of greater aerodynamic efficiency will be built. The family-size helicopter will require an engine more nearly comparable with that of the present family car. New and unpredicted experiences awaiting the postwar world may include public service helicopters taking the place of street cars, buses and elevated railway systems. It is stated that taxicab and intercity bus service is almost certain to become the field of the helicopter. The difference between the helicopter and the autogiro is explained. A conception of a helicopter of the future with a landing gear suitable for use on land or water is shown. *Aviation and Yachting*, December, 1943, pages 13, 41, 43, 1 illus.

Stress Analysis

Notes on Columns. Paul E. Sandorf. Methods are presented for the determination of the failure loads of continuous columns that are elastically restrained at the supports. By means of accompanying charts, the effect of elastic restraint can be obtained as a simple multiplying factor to be applied to the Euler load. The variations in column rigidity due to plasticity and skin-buckling are discussed, and note is made of effects of eccentricity of loading which are always present to some extent in practical structure.

Certain assumptions that are usually made in the design and in the testing of aircraft column structure are shown to be precise only to within 10 or 15 per cent. A method of testing is described by which column effects may be investigated more thoroughly. The calculation of the compressive strength of aircraft panel structure from the design characteristics is suggested in the place

comin' in on a wing and a prayer*—AND HYATTS!

OUT OF THE SMOKE OF BATTLE, out of the range of the enemy . . . a bomber limps home with a wing, its tail, belly, and two of its four engines shot full of holes.

It has dumped another load of bombs over the Rhineland today... punched some more holes in the Axis industrial machine. But, like the men who man them, these planes must be built to "take it" as well as "dish it out."

This...in a word...takes "guts." After all, it is what's inside the shell that really makes a plane tick when the chips are down.

Inside are hundreds of precision parts...parts that are knit into unfailing strength. Prominent among these parts are the smooth rolling Hyatt bearings into which we build great capacity while holding them true to required precision tolerances.

At Hyatt, you see, we developed and use the centerless I.D. grinding process exclusively, and this always assures the uniform wall thickness of our bearing races...therefore, perfect concentricity, perfect balance.

A perfectly circled raceway prevents eccentricity... the main cause of *vibration*, one of the things that could spell disaster for a plane and its engines.

By minimizing vibration, increased horsepower is helped made possible. And this increased power is mighty comforting to flyers "comin' in on a wing and a prayer."

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HYATT BEARINGS
DIVISION OF
GENERAL MOTORS
HARRISON, N. J.

of the usual assumption of an effective end-fixity coefficient of 1.5. *Journal of the Aeronautical Sciences*, January, 1944, pages 1–12, 7 illus.

Strain Energy Analysis of Incomplete Tension Field Web-Stiffener Combinations. Paul H. Denke. This paper presents a minimum potential energy analysis of thin web beams subjected to shear loads above critical. The wave form of the buckled surface is approximated by a function that contains the wave length, wave angle, and wave depth as parameters. Four more parameters—namely, the stiffener compressive strain, the cap compressive strain, the cap bending deflection, and the panel shearing strain—are introduced, and the distribution of the mid-plane tensile, compressive, and shear stresses is worked out. The energy of the entire panel-load system is then computed and the resulting expression differentiated with respect to the strain parameters. The seven resulting equations define the equilibrium configuration of the panel. Expressions are obtained for the critical condition, principal mid-plane stresses, maximum web bending stresses, stiffener and cap compressive stresses, web wave length, wave angle, and wave depth. In particular, a formula is given for the bending loads on the stiffeners produced by the wrinkling of the web. The equations are shown to reduce to those of Wagner for an infinitely thin web. A comparison is presented which shows good agreement between theoretic and experimental values of the following: principal web stresses, stiffener compressive stresses, wave depth, and wave length. *Journal of the Aeronautical Sciences*, January, 1944, pages 25–40, 17 illus.

Column with Equal-Spaced Elastic Supports. Shou-Ngo Tu. The buckling load of a column with equal-spaced elastic supports is calculated by solving a difference equation of the second order. Two types of end conditions are considered: simple supported and built-in. In each case, a column with one, two, or three intermediate supports is examined. An asymptotic expression is derived for the case when the number of supports approaches infinity. *Journal of the Aeronautical Sciences*, January, 1944, pages 67–72, 75, 5 illus.

Stress Problems in the Design of Wooden Airplanes. Zbigniew Krzywoblocki. Stress problems in wood design encountered in previous years are presented. Starting with the difficulties of the mutual interaction between wood and plywood, the problems of the strength/weight ratio and of brittleness and vibration are discussed. The paper concludes with an analysis of the present state and the probable future development of the construction of wood airplanes. *Journal of the Aeronautical Sciences*, January, 1944, pages 76–82.

Vibration Frequencies of Continuous Beams. Edward Saibel. A method is developed for finding the natural frequencies of vibration of a continuous beam from a knowledge of the natural frequencies and natural modes of the beam supported at the ends in the same manner as the continuous beam but not subjected to any of the constraints between the ends. The method is easily applied and can be carried out to any desired degree of approximation for any number of modes of vibration in a quick and simple manner. Calculations are given for two cases, the second of which is related to the problem of the braced cantilever wing. *Journal of the Aeronautical Sciences*, January, 1944, pages 88–90.

Deflection of Uniformly Loaded Circular Plates. F. C. W. Olson. The equation for small deflections of a uniformly loaded and supported circular plate is rewritten so that the two constants of integration are interpreted as the center deflection ω_0 and a boundary parameter α. Stresses and bending moments are given in terms of ω_0 and α. It is noted that a particular advantage of this treatment is that the nature of the support may be found experimentally even if the elastic constants, plate thickness, and load are unknown. The energy method is used to develop a more general theory of large deflections, valid for any condition of uniform support at the edge. *Journal of Applied Mechanics*, December, 1943, pages A-181, A-182.

Some Notes on the Shear Centre of Thin-Walled Open Sections. T. Haas. It is noted that, although the method of finding the shear center of open sections is now well established, the number of readily usable solutions for sections common in practice is small. In this paper consideration is given to a more complicated section, fairly common in practice, and a formula is derived for the location of its shear center. The section is a lipped channel, symmetric about one axis. The paper is followed by a diagram that enables the shear center position for various ratios of lip to leg and leg to web to be read off.

A short review of available literature on the determination of the shear center is presented at the end of the paper to ease the designer's work when looking for applicable formulas. *The Journal of The Royal Aeronautical Society* November, 1943, pages 383–389, 6 illus.

Failure from Creep as Influenced by the State of Stress. W. Siegfried. That the behavior of metals at high temperatures could be explained by the combined action of the crystals and the so-called grain boundaries was pointed out by Rosenhain and Ewen as early as 1912. This theory was used later to explain problems connected with creep phenomena. The writer discusses subsequent studies in the United States and Germany relating to the occurrence of brittle fractures in metals after long periods of time. With the aid of the Rosenhain-Ewen conceptions, he attempts to reconcile discrepancies between recent observations on the occurrence of intercrystalline fractures after long test periods. His evaluation of the theories cited offers an explanation of various phenomena that previously could not be interpreted and also furnishes a basis for determining the risk of failure with creep in a three-dimensional system of stress. He concludes that the problem of calculating the strength of a material subjected to creep is actually solved only when the metallurgist and the steel manufacturer are in a position to furnish the designer with complete experimental data, enabling him to predict failure for all systems of stress occurring in practice. *Journal of Applied Mechanics*, December, 1943, pages A-202–A-212, 27 illus.

An electrical device is tested in a high-altitude test chamber designed by Westinghouse engineers. In this chamber electric generators, motors, and controls are subjected to conditions of temperature, pressure, and humidity equivalent to that experienced by aircraft. (*See* page 201.)

Superchargers

Supercharging Aircraft Engines. Part. I. Paul Hoffman. The first section of a two-part article on the purposes and methods of supercharging aircraft engines begins with a brief review of the working principles of the internal-combustion engine. The effects of the decreasing density of the air at increasing altitudes are explained, with remarks on the changes in temperature. Mathematical formulas are worked out for the calculation of relative density of the air, indicated horsepower, and brake horsepower at different altitudes. A definition of supercharging is given, with an explanation of the principles upon which superchargers operate, and the remedies to be applied to offset the power lost in driving the supercharger.

Conclusions are reached to the effect that: (1) The temperature rise during compression requires a greater rate of supercharging than would otherwise be needed; (2) to reduce the temperature rise and the required pressure ratio, the best possible efficiency of the supercharger is required; and (3) above a certain altitude, compression must be followed by cooling in order to keep the pressure ratio of the supercharger

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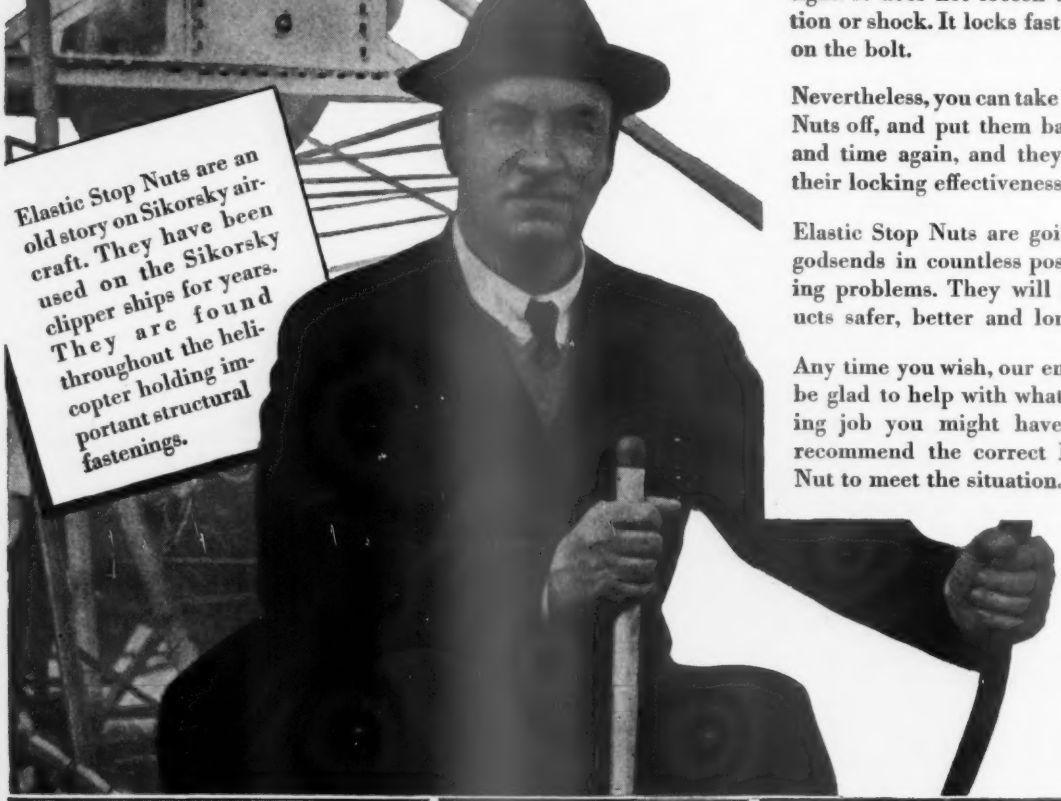

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within practical limits. Charts show the variations in pressure at different altitudes, changes in engine power and in atmospheric density, rates of supercharging, temperature rises, power absorbed by a supercharger, and net engine horsepower with and without supercharging. An appendix to the first part of the article gives formulas for computing compression ratios. *Commercial Aviation*, November, 1943, pages 122–124, 126, 128, 130, 132, 134, 10 illus.

Raising the Roof with Turbosuperchargers. Bernard Scoville. This article outlines in nontechnical language the function of the supercharger and describes recent supercharger developments. Particular reference is made to the turbosupercharger and how its use has aided in raising the ceiling of American warplanes. *Aircraft Age*, February, 1944, pages 32, 33, 59, 60, 5 illus.

Testing

Tension Meters. Rough sketches accompany some brief details on two tension meters—one developed for testing fabric-covered control surfaces; the other, for testing control cables. Both tension meters work on the principle of measuring the sag produced by a spring-loaded plunger bearing on a fixed span of fabric or cable. *Flight*, November 18, 1943, page 555, 2 illus.

Tools and Equipment

Tooling Simplifies Inspection. V. E. Childers. A description of the improved tooling methods and special gauges employed by the Vultee Field Division of Consolidated Vultee to facilitate production inspection. Details are given on two types of tools. One fabricates parts to such exactness that the necessity for inspection of parts before assembly is practically eliminated. This type stems from master tools to which all other manufacturing and inspecting jigs and fixtures are coordinated and is exemplified by various components of the B-24 engine assembly line. Particulars are given also on the building of the master tools.

The other type is the inspection tool that simplifies elaborate inspection procedures into mechanical checking, reducing the time required and minimizing the need for skilled inspection personnel. The wing-junction butt fittings inspection gauge and the inspection gauge for elevator assemblies are studied as examples of the latter type of tool. *Western Flying*, December, 1943, pages 46, 47, 114, 6 illus.

Degreasing for Greater Efficiency in Production. With particular reference to those manufactured by G. A. Blakeslee & Company, Ltd., the purpose and applications of degreasers and metal parts washing machines in aircraft plants are described. It is related how the removal of dirt and oil from aluminum alloy prior to anodizing, assembly, or inspection and from subassemblies prior to heat-treating is accomplished by the degreasing equipment. Details are given also on machines for typical specialty cleaning problems. In the latter group is a degreaser designed for cleaning the protective coating from machine guns prior to installation in Vickers PBY aircraft, and a washing machine designed particularly to clean aircraft components on a production basis prior to inspection and assembly. *Commercial Aviation*, November, 1943, page 120, 5 illus.

This large clamp at the Westinghouse Electric and Manufacturing Company plant in Mansfield, O., holds a sheet of aluminum in place while a powerful air-operated ram shapes it to fit the tail cone of a Republic P-47 thunderbolt fighter plane. Workers are shown removing the sheet after it has been shaped.

Ingenuity Encouraged at Ottawa Car and Aircraft Limited with Outstanding Results. Keith Edgar. This article on the production procedures of Ottawa Car and Aircraft, Ltd. features the timesaving and laborsaving innovations that have been instituted at the suggestions of employees. Among the inventions described are the following: an automatic stamping machine that has stepped up operations from 20 to 100 per min.; a fulcrum profiler, made from scraps of machines, which runs three times faster than the original profiler; a speedier method for drilling holes in fabric-clamping strips; a pilot and die arrangement for dimpling material before riveting; a tool for deburring the edge of metal; a rack to hold hinge brackets for Hurricanes, eliminating 90 per cent of the aluminum wire hitherto used for wrapping the material; and a hydropress with rubber dies for stamping out a flap spar in two operations. *Canadian Aviation*, November, 1943, pages 59, 60, 86, 8 illus.

Glass Gauges. Design features of glass gauges are explained, their advantages over steel gauges are cited, and trends with regard to their future development are forecast. Advantages attributed to glass gauges include the following list: (1) visibility in inspection; (2) freedom from corrosion; (3) elimination of greasing during shipment and storage; (4) no effect on gauging dimensions from the body heat of the inspector, as the thermal conductivity is less than that of steel; (5) scratching and slight chipping does not cause burrs or change its gauging functions; (6) where the part under inspection is close to the size of the gauge there is less tendency for "seizing"; (7) there is more sensitive "feel" when using a glass gauge; (8) for gauging applications, glass appears to have abrasion-resisting qualities superior to those of steel. *Aircraft Production*, December, 1943, page 574.

Metallizing in Tooling. G. C. Close. Procedures for metal-spraying to prolong the usefulness of tools and to salvage worn or corroded tool parts are detailed. Possibilities, as well as limitations, of the process are indicated by a brief description of the metallurgy of sprayed metal. Among the applications examined are those for building up worn parts such as line shafts, journals, bearings, pistons, and piston rods; restoration of precision tool parts; resurfacing of dies worn beyond acceptable tolerance by continued use, especially Kirksite dies used in drop-hammer forming; the preservation of wood patterns; reconditioning items deteriorated by heat corrosion or oxidation, by means of "aluminizing"; and preventing corrosion of various tanks or containers used for processing solution. Methods of obtaining the best results in preparing the surface to be metallized and in actual appliance of the sprayed metal are advised. *Western Flying*, December, 1943, pages 63, 64, 136, 4 illus.

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Piston Rings for Oxygen Compressor
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Rubber Press Is Solution to Many Stamping Problems. E. W. Lloyd. Methods devised to solve engineering and manufacturing problems connected with the production of components of the Lancaster bomber by the Ottowa Car and Aircraft, Ltd., especially the production of the flap spar, are related. The two operations by which the part was made are described. The first was the formation of the flange on a Masonite form block set on a steel base on a hydraulic press. The second operation was more difficult because the finished spar usually came off the form block with a decided twist, making the spar useless.

A solution was found by forming the spar with a rubber pad on a hydraulic press, using a steel die having a narrow base to allow for spring back. Details are given on the process employed and the materials used. It is stated that other parts such as bomb bay door ribs, aileron ribs and noses, and leading edges for the wing tips were made by the restrained rubber pad method. *Canadian Aviation*, November, 1943, page 96, 1 illus.

Diamond Turning. From experiments conducted on aircraft pistons results are recorded on investigations into factors governing the quality of turned finishes obtained with diamond tools.

The report includes information relative to graphic surface measurement, the tests that were sponsored by the Ministry of Supply, and cutting data, in addition to notes advising on diamond-turning procedures. In a summary of the data provided by the tests, the following conclusions are offered:

(1) Visual judgment of surface finish may be unreliable. (2) Machines should be properly counted and all possible steps taken to eliminate vibration. A correctly mounted spindle is essential. In the light of previous experience, plain bearings are preferred. (3) A tool with a perfectly polished cutting edge is essential; no fault in the cutting edge should be apparent at 100 magnifications. (4) Care and patience are necessary when setting the tools. They should be on or slightly above center, and, if a tool with a facet edge is used, the facet should be set parallel to the work. (5) Cutting speeds should be below the natural vibration speed determined by the machine fixture, work, etc. (6) Within limits, feed and depth of cut have little effect on the quality of the surface finish. (7) Although coolants do not appear to exercise a very great influence on the results, it is desirable to use some form of coolant to keep the cutting edge of the tool free from swarf. The swarf should have a smooth silky feel.

The article contains the admonition that the outlined test results could not be accepted unconditionally, since there is still a large field for exploration. *Aircraft Production*, December, 1943, pages 592–594, 4 illus.

Training

How Gunners Learn to Wing 'Em. Part V. The fifth in a group of articles on the training schools of the U.S. Army Air Forces is concerned with gunnery instruction. The training of fighter pilots in shooting techniques is exemplified by procedures of the fixed gunnery school at Eglin Field, Fla.; the training of bomber gunners is described by the methods in practice at the flexible gunnery training school at Tyndall Field, Fla.

Combining ground-school studies of theory with actual gunnery practice, the course at Eglin Field lasts approximately 11 days and is given to cadets in the latter stages of advanced flight training. In addition, Eglin conducts a regular school for gunnery instructors. The 6-week course at Tyndall advances the student from "bead work," through shooting at moving targets with BB and skeet guns, to 0.30- and 0.50-caliber ground machine guns, and finally to shotgun turrets. During this period they are also versed in the construction of guns and the principles of ballistics. Besides outlining the courses and noting features of each instructional system, the article mentions and includes photographs of different training devices employed. *Aviation*, December, 1943, pages 221 223, 225, 304, 305, 307, 308, 7 illus.

Basic Procedure for Air Power. R. G. Worcester. An outline of the minimum information a pilot must have to fly any airplane. The writer discusses "mechanical" drill and cockpit drill. Instructions are given in the detailed procedure that should be carried out with respect to each of the operations involved in preparing an airplane for flight, during the flight, and in landing. *Aeronautics*, December, 1943, pages 48–50.

The A.T.C. of the Future. C. G. Grey. Commenting upon the diminishing size and enthusiasm of the Air Training Corps, the writer advises certain remedies. He suggests that the age at which youngsters can enter the A.T.C. be lowered to 15 so that the group can compete fairly with other British Cadet Corps. He also states that there is need for a weeding-out among the A.T.C. officers in order to raise the efficiency of the squadrons and increase the loyalty to the Corps. In addition, he believes that publicity should be given to the reasons why it is fallacious for prospective cadets to think that the war will be over before they can get into the R.A.F. *The Aeroplane*, November 12, 1943, page 554.

Out of Bed—Into Action. Albert Q. Maisel. How Army Air Forces Convalescent and Rehabilitation Training programs function is related. The work carried on at Jefferson Barracks, Westover Field, Miami Beach, and elsewhere is described, showing how ill and injured men are taught to maintain the skills they had or to learn new crafts during the time spent in convalescence. Credit is given to the accomplishments of the Air Forces surgeons in getting

In a Curtiss-Wright sponsored program, "engineering cadettes" are shown witnessing a wind-tunnel demonstration at Purdue University as part of their 10 months' training in aeronautical engineering. Six hundred and thirty of these girls were trained at seven of the nation's leading colleges and universities to relieve a shortage of engineers.

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the men back into active service in a shorter time than was possible in earlier wars, while greater progress is shown in making soldiers more useful to the nation and to themselves. Particular attention is being given to the reintegration of the men into civil life, with a view toward the problems that will follow the end of hostilities. *Air News*, November, 1943, pages 34, 35.

Training on Real Parts and Real Planes. Particulars are given on three of Consolidated Vultee's instructional programs: the Vocational, Apprentice, and Supervisory. In the description of the Vocational program, the four phases of pre-employment, prefactory, upgrading, and supplementary training are outlined. The Apprentice program covers a 4-year course in which four fields are dealt with: aircraft electricians, machinists, sheet metal workers, and tool- and diemakers. The Supervisory course consists of training in foremanship, leadership, and job instruction. *Wings*, November, 1943, pages 749–751, 9 illus.

Services' Proving Grounds Test New Warplanes in Mock Battles. The routine for testing a new model of Army combat aircraft is outlined. Upon the completion of the first plane of a new design, the manufacturer's test pilots give it a thorough trial while Army test pilots observe the results. After the builder has satisfied himself of the combat worthiness of the plane, it is turned over to the Army at Wright Field, where the Flight Section imposes severe tests for speed, ceiling, critical altitude, rate of climb, and other performance characteristics with the aid of modern testing and recording equipment. This is followed by accelerated service trials in which efforts are made to develop maintenance weaknesses and to ascertain whether the plane will stand up under the strain of front-line warfare. After passing this phase of technical testing, the plane goes to Eglin Field for what is know as tactical testing, where it is subjected to conditions comparing as closely as possible with actual combat, carrying full military equipment and flown by a newly trained fighter pilot. Information is given on how new planes are compared with existing types and on similar test routines carried out by the Navy at Patuxent and elsewhere. *Aviation News*, December 27, 1943, pages 16, 18.

Running Start. William D. Strohmeier. Comments are made on the merits of training in light planes, starting with an outline of the new War Training Service program for cadets. The writer takes the position of defending the program against the arguments of critics who favor primary training without the W.T.S. background. The difficulties encountered by the student who enters primary training without having flown before are recounted, with emphasis on the advantages for the instructor who can start his classes on flight maneuvers without the laborious process of teaching the fundamentals. The arguments of the opponents of the plan involving the college training detachments of the W.T.S. are refuted, although it is held that certain features of the program could be improved. Three sources of dissatisfaction with the program are analyzed and suggestions are offered for overcoming them. *Air Facts*, January, 1944, pages 18–22.

The U.S. Navy's new Curtiss (SB2C-1) Helldiver dive bomber.

Production Line Maintenance. Col. Charles E. Cox, Jr. The production-line maintenance system of the Army Air Forces Western Flying Training Command is outlined. Among the points covered are the organization breakdown, division of work, physical setup of maintenance depots, training and grading of personnel, working procedures, and advantages of the scheme. *Western Flying*, December, 1943, pages 50, 51, 106, 3 illus.

Airmen of Tomorrow. William Wavell Warfield. A description of the organization, activities, and curricula of the British Air Training Corps. *Aircraft Age*, February, 1944, pages 22, 23, 56, 5 illus.

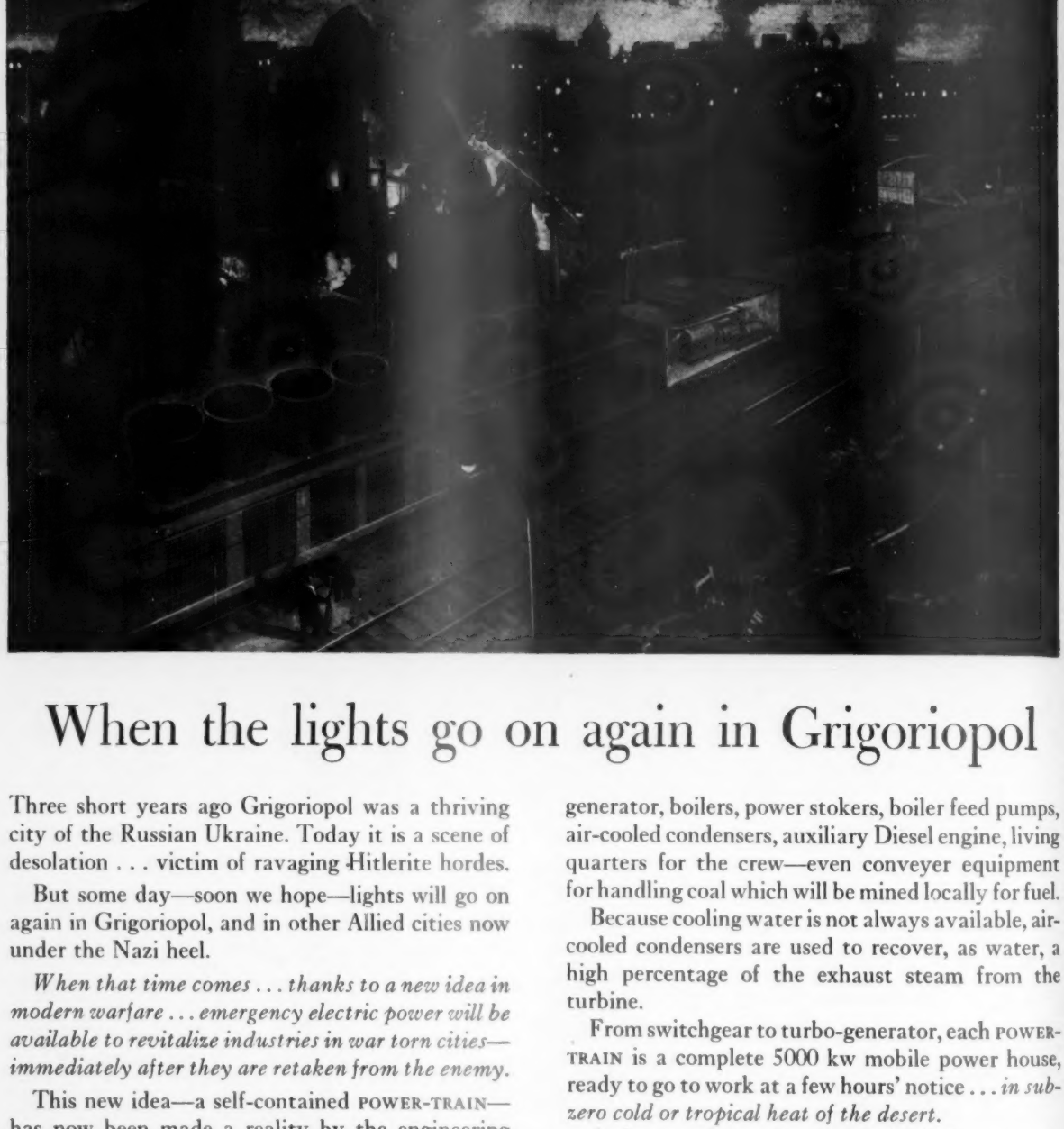
"Air Age" Education. Herbert E. Wrinkle. An article by the State Service Director of the University of Oklahoma on the ways in which aeronautical development will affect the educational system of the United States. Changes in the curricula of all schools—elementary, high school, and college—and in varied subjects are envisioned. *Airlanes*, November, 1943, pages 10, 29, 1 illus.

Learning the Liberator. C. W. Greaves. An article on Camp Consair, the training school operated by Consolidated Vultee Aircraft Corporation in conjunction with the Army for the purpose of training military personnel and company employees in maintenance of Liberators. Covering a period of 28 days, the specialization course is given to personnel already possessing a good foundation in aerodynamics and aircraft mechanics. Descriptive information follows the four phases of instruction: (1) general airplane, including flight controls; (2) hydraulic system, including landing gear; (3) electrical system; (4) engine change, engine run-up, and fuel system. *Western Flying*, December, 1943, pages 52, 53, 116, 118, 7 illus.

Warfare

Retrospect. Major F. A. de V. Robertson. A general summary of the R.A.F.'s activities during the past year. Air operations are broadly divided into two classifications: independent actions as carried out by bombing attacks on German territory launched from the British Isles, and combined operation with the Army, as organized and enacted in the Mediterranean area. Some statistics are given on the amount of bombs dropped, percentage of Axis targets destroyed, amount of enemy shipping sunk, etc. *Flight*, November 18, 1943, page 566.

Shuttle-Bombing. E. Jay Doherty. The significance of shuttle bombing is interpreted. With the gradual acquisition of more and more Allied bases, the increasing importance of this technique to the strategic bombing operations of the United Nations is depicted. The military advantages of shuttle bombing are outlined as follows: (1) It enables crews to take off in weather they could not land in, so long as their ultimate destination is clear. (2) It forces the enemy to disperse his fighter and ground defenses to protect his territory over a longer stretch and from both directions.



When the lights go on again in Grigoriopol

Three short years ago Grigoriopol was a thriving city of the Russian Ukraine. Today it is a scene of desolation . . . victim of ravaging Hitlerite hordes.

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From switchgear to turbo-generator, each POWER-TRAIN is a complete 5000 kw mobile power house, ready to go to work at a few hours' notice . . . *in sub-zero cold or tropical heat of the desert.*

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(3) It increases the ranges of bomber operations from a given base. (4) It enables pilots to take advantage of favorable winds. (5) It affords a profitable method of shifting bomber forces for concentration at the points of greatest need. (6) In rare cases it permits taking advantage of longer hours of daylight or of darkness, depending upon the direction and length of flight. *Flying*, January, 1944, pages 26, 27, 116, 1 illus.

Bomb Bridge to the Philippines. Alexander Kiralfy. A discussion of military operations and possible future movements in the southwest Pacific theater of the war. It is pointed out that General MacArthur's bombers are bringing Allied land forces much closer and more rapidly to the Philippines than is generally realized. Allied air power is building a timesaving bridge from New Guinea and the Solomon Islands to Mandanao, the southernmost island of the Philippines. Information is given on the proposed routes, the opposition that may be expected from the enemy, and the means to be employed in achieving final victory. *Flying Aces*, February, 1944, pages 12, 13, 40–42, 4 illus.

Russian Air Bases? Alexander Kiralfy. The question of whether Allied bombers could effectively attack Japan if provided with bases in Siberia is considered, together with the corollary problem of what the Japanese defense against such operations would be. It is shown that Japanese targets are more concentrated and easier to locate than those in Europe, and that her water and land communications are exceptionally vulnerable. On the other hand, the analysis demonstrates that, in addition to greater problems of distance and supply, the Allies would find flying conditions and the defense of airfields much more difficult than on the European front. The necessity for bombers of greater range or for more bombers per mission, larger numbers of transport planes, possible supplementary land and amphibian operations, and assisting in the defense of Siberia are all numbered in the conclusions. *Flying*, January, 1944, pages 48, 49, 138, 144, 3 illus.

Welding

Aluminum Brazing Sheet—Fundamentals of Metal Flow. Mike A. Miller. A number of experiments were carried out in order to determine the amount of metal which flows from the surface of aluminum brazing sheet, under various conditions, to form a joint. The percentage of flow is considered from the standpoint of the process used, the type of joint, the flux, the type of brazing sheet, etc. These data serve as a basis for discussing several types of joints used with aluminum brazing sheet, as well as some applications of this product. In addition, various other factors related to the brazing of aluminum alloys are mentioned, the emphasis being on aluminum brazing sheet products. *The Welding Journal*, December, 1943, pages 596-s–604-s, 16 illus.

Metallic Arc Welding of X4130 Steel Tubing. Wm. T. Tiffin. Research on the metallic arc welding of tubing for aircraft, made from X4130 analysis steel, is described. The properties and characteristics of the welds are analyzed and discussed. In summarizing the subject it is stated that the most satisfactory welds in X4130 tubing are those produced with the maximum current value that can be handled by the operator. *The Welding Journal*, December, 1943, pages 613-s–615-s, 6 illus.

Experiments with the Fabrication of an Aero Engine Exhaust Manifold in Austenitic Chromium-Nickel Steel. K. J. B. Wolfe. A report is made of experiments carried out to find suitable materials and welding techniques for the production of a radial aircraft engine exhaust manifold. It is shown that austenitic sheet materials recommended as "immune from weld decay" suffer intercrystalline corrosion under the Hatfield test after welding. It is necessary to use a molybdenum-bearing 18/8-type of sheet material, and an 18/8 electrode has been produced containing both molybdenum and columbium as stabilizing agents. Welds produced by these materials are found not to suffer under the Hatfield test. The physical condition of the welds was determined by means of the Olsen ductility test.

The electrochemical potential differences between various materials in the sheet and weld-deposit form are determined. The results obtained indicate why failure has occurred in some of the welds. Two different electrolytes were used in these tests: the first, a 3 per cent aqueous hydrochloric acid; the second, the Hatfield reagent, used boiling.

Sections of the article discuss the problems involved in the use of austenitic stainless steel, methods of fabrication, the choice of welding technique, the types of electrode used, the choice of material and the electrodes to be used, experiments using miscellaneous sheet materials, electrochemical experiments, and methods of determining potential differences. *The Institute of Welding*, Quarterly Transactions, July-October, 1943, pages 123–134, 26 illus.

Heavy-Gauge Spot Welding. Some experiments carried out by Westland Aircraft, Ltd., in the spot welding of heavy-gauge material are related. After reviewing earlier misconceptions concerning such work, the machine used and the modifications made on it are described. Details are given on the electrodes employed. A technique is recommended, with comments on the experience from which the recommendations arose. A new transformer developed for the purpose was found to enhance the speed of the entire operation. In closing, the writer gives advice about cleaning the work preparatory to welding. *Aircraft Production*, December, 1943, pages 563–565, 6 illus.

The Spot Weldability of Low Carbon and Other Aircraft Steels. Leon C. Bibber and Julius Heuschkel. This paper presents a large mass of information showing the effect on spot weldability of varying the strength of steels of the same nominal composition. All materials were welded and tested in the same general way so that direct comparison between them is possible. Approximately 4,000 specimens were tested during the investigation.

The writers state that the most important part of the work is the establishment of the relationship between the spot weldability of the different tempers or grades of steels of the same nominal composition. Opinions are expressed on the spot weldability of specified steels.

The information is intended to aid the engineer in arriving at decisions on what parts of airplanes and other structures should be fabricated from the various grades of steel. *The Welding Journal*, December, 1943, pages 616-s–632-s, 51 illus.

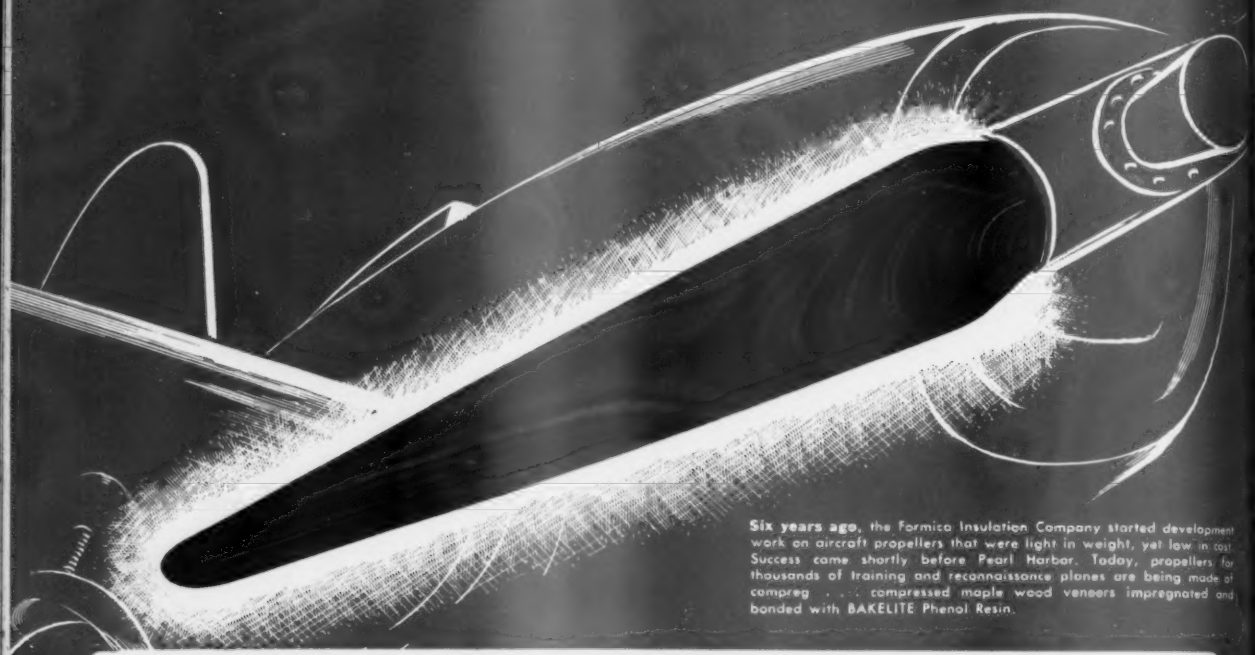
Wind Tunnels

An Australian Wind Tunnel. The main features of the 9- by 7-ft. octagonal wind tunnel constructed at Fishermen's Bend are described in this report. The tunnel forms one of the major items of equipment of the Division of Aeronautics of the Council for Scientific and Industrial Research. The maximum wind speed of the tunnel is 286 ft. per sec. Power is furnished by a 550-hp. electric motor operating at 700 r.p.m. The tunnel is constructed largely of welded mild steel. Following an outline of the general design and construction, information is given on the electrical equipment, the calibration of the tunnel, the balance, and subsidiary equipment. *Aircraft Engineering*, November, 1943, pages 310–316, 19 illus.

Miscellaneous

Air Industries and Transport Association of Canada. A report on the annual meeting of the Air Industries and Transport Association of Canada, held at Toronto on November 15, 1943. In addition to noting some of the Association's plans and recommendations and problems of the industry as discussed at the meeting, the article reviews the main points of addresses made by Fred T. Smye, Director of the Munitions and Supply portion of the Canadian Production Program, and Wayne W. Parrish, President of the Aviation Writers Association. *Canadian Aviation*, December, 1943, pages 70, 71, 6 illus.

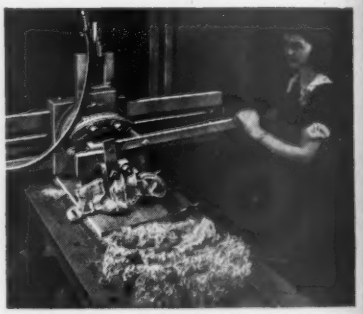
How can BAKELITE Plastics



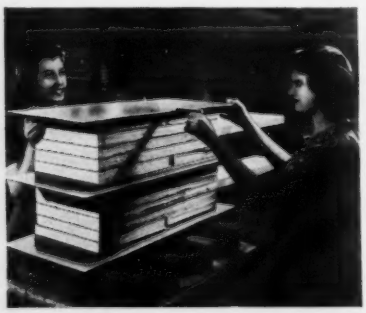
Six years ago, the Formica Insulation Company started development work on aircraft propellers that were light in weight, yet low in cost. Success came shortly before Pearl Harbor. Today, propellers for thousands of training and reconnaissance planes are being made of compreg . . . compressed maple wood veneers impregnated and bonded with BAKELITE Phenol Resin.

Choice maple veneers are placed in a cage, lowered into a vat of BAKELITE Phenol Resin. Vacuum, then pressure, assures complete saturation into the wood of this thermosetting resin. Later the veneers are removed and stacked to dry.

The impregnated veneers are then laid up and placed in a hydraulic hot-press. Here the heat softens the resin, the pressure compresses the wood to one-half its original thickness. Under continued heat, the resin sets. The result is a plank of compreg.



Here a worker is shown planing the densified wood block to assure perfect bonding in later operations. Measured in the grain direction these compreg planks can be said to have a weight-strength ratio of one-half the weight per volume of aluminum.



The planks of compreg are then coated with BAKELITE Phenol Resin and laid up to form the rough shape of the finished propeller blade. The metal plates dividing each unit are electrodes that will carry the high-frequency current used to bond the compreg planks to a single block of densified wood.

In the electrostatic press, high-frequency electrical current is passed through the entire propeller assembly, generating uniform heat throughout its entire depth. This is extremely important since only hot-setting resins can give the necessary bond, and since the tremendous thickness makes it impossible to use the steam platen or oven-heating processes.

After removal from the press, the blocks are rough-cut, then finished to form lightplane propeller blades. Although made of wood, these blades are water-resistant . . . have a tensile strength of 30,000 pounds per square inch, flexural strength of 40,000 pounds, and sheer strength of 8,000 pounds.

improve your products?

Can you produce them faster? . . . Can you improve them structurally, electrically, mechanically? . . . Can you build them at lower cost? The answer has been "Yes" for hundreds of products whose manufacturers have investigated BAKELITE Plastics.

Complex shapes are being molded quicker . . . resulting in sturdy, finished parts at remarkably low cost. Coatings and finishes have been developed with BAKELITE Resin bases that are easier to apply, and that are far more durable and resistant. Wood has been given new strength and endurance . . . is now being fabricated in curved plywood sections up to 84 feet in length. Cloth laminated with BAKELITE Laminating Varnishes saves 45 per cent in weight of fighter plane ammunition boxes.

These and other examples illustrated on these pages are typical of the scores of applications and developments that you will keep posted on when you are in touch with Bakelite Plastics Headquarters. Our Engineering Staff and Development Laboratories can help you with essential problems. The literature illustrated below can help you with your present and postwar planning.

Write for specific technical literature today. Please address Dept. 25.

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Unit of Union Carbide & Carbon Corporation
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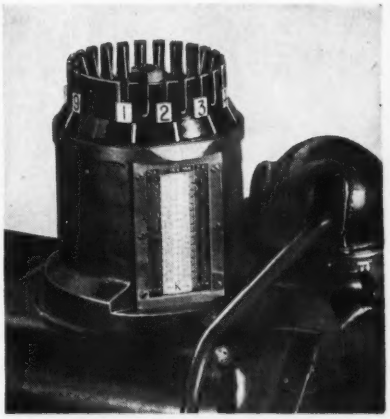
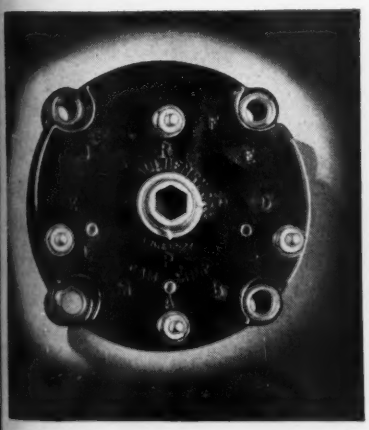
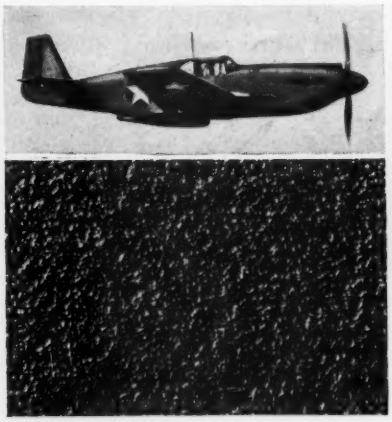


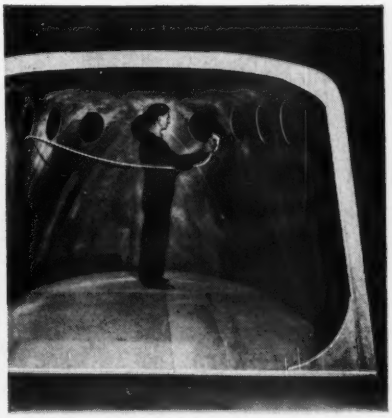
The preselector dial drum that automatically figures the gear ratios and speeds in the use of a No. 5 Warner & Swasey turret lathe was formerly made of metal. It is now molded of a BAKELITE *General Purpose* Phenolic Plastic eliminating several machining operations. The conversion has meant an important savings of metal and a reduction in production costs of approximately 80 percent.



After designing a new type rotary cam selector switch for sequence switching on airplanes, the Paul Henry Company found that simplified production and low cost demanded the use of a molded plastic. But which one? Experimentation pointed to a BAKELITE *Impact-Resistant* Phenolic. Further tests proved this material to have good electrical characteristics, high impact and tensile strengths, excellent heat and moisture resistance. Sales are up, production costs are down 20 percent...because this manufacturer investigated BAKELITE Plastics.



On the steps, catwalks, and cockpit floors of military aircraft, a covering that will withstand wear, yet be skid-proof, is absolutely essential. Rubber is slippery when wet. Other materials wouldn't stand the abuse. The Western States Lacquer Company developed an abrasive coating, particles of hard aggregate suspended in a rubber-like BAKELITE Plastic base. Sprayed or troweled on, this new coating gives a resilient, sandpaper-like surface to the flooring of some of America's leading bombing and fighter planes.



Deck houses for small boats are now being molded of plywood in a single piece. At the Haskelite Manufacturing Company's plant, veneers of wood coated with BAKELITE Resin Glue are laid in diagonal strips over a mold. Then low fluid pressure and controlled heat are applied which forces the plywood assembly to the exact contour of the mold and sets the glue. The finished deck house is 12 feet long, 9½ feet wide, and 8 feet high. It is light, strong, and durable.

USEFUL LITERATURE ON PLASTICS

"A Simplified Guide to Bakelite Plastics" gives a summary of the principal BAKELITE Plastics now available. It describes each type briefly, and illustrates typical applications. **"Bakelite Molding Plastics"** provides further information, and A.S.T.M. data on moldable plastics. **"Molding Technic for Bakelite and Vinylite Plastics"** is a 224-page manual on the art of molding plastics. It contains comprehensive data that the designer, engineer, molder, and user should have on the design and fabrication of hot-set and cold-set molding materials. Price $3.50 postpaid. Additional pamphlets and booklets describing other types of BAKELITE Plastics are also available. Write to Department 25, requesting these valuable guidebooks.

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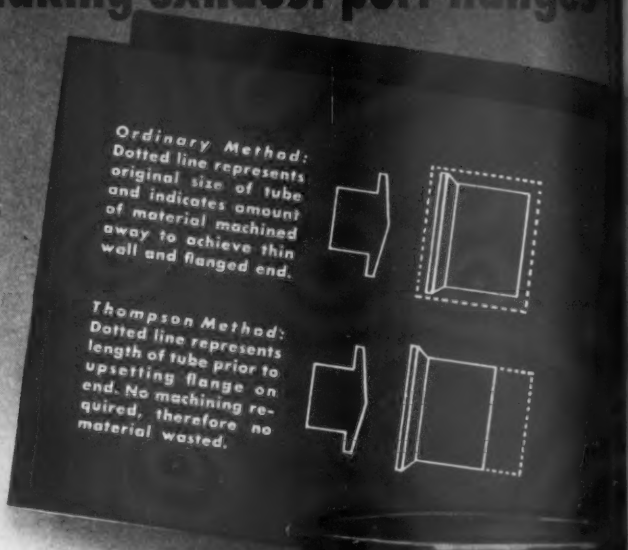
PLASTICS HEADQUARTERS

How cutting corners in making exhaust port flanges may solve a production problem FOR YOU!


Ordinary Method: Dotted line represents original size of tube and indicates amount of material machined away to achieve thin wall and flanged end.
Thompson Method: Dotted line represents length of tube prior to upsetting flange on end. No machining required, therefore no material wasted.

HERE is one example of a manufacturing short-cut that gave greatly increased parts production, reduced the cost, and actually improved product quality over other methods. It may prove the solution to one or more of your production problems—*whether it's exhaust port flanges or any other similar part adaptable to these Thompson methods* . . .

Many lathe operations and other production steps were necessary in making Collector Ring Exhaust Port Flanges from thick-walled tubing. To produce the flanged section, excess stock had to be machined away from the rest of the tube. Machining time—and material wasted—were costly, tolerances were difficult to maintain, and smooth surfaces were hard to achieve, resulting in weakness that caused breakage in service.

In ordinary hot-gathering and forging methods on tubing, collapse often occurs if more than three thicknesses are gathered. But Thompson engineers developed an electrically and hydraulically operated machine that enables as high as *twenty* thicknesses to be gathered. So, starting with *thin*-walled stainless steel tubing (and thus eliminating the machining usually required) Thompson hot-gathers the flange on one end of the tube and forges it to exact shape in a percussion screw press. Finishing steps are sand-blasting, restriking cold to smooth up the surface, removing of flash, boring out to required tolerance—*and the flange is complete!*

ADVANTAGES OF HOT-GATHERING

One of the most important advantages of hot-gathering tubing, or any other part to be forged to shape, is the grain flow produced. In this application, the grain flow follows the contour of the forged section as shown in the inset below, *thus increases strength properties many times . . . right where strength is needed most!*

Thompson engineers will be glad to discuss your production problem with you, and furnish full information on the Thompson manufacturing facilities adaptable to your needs. In making exhaust port flanges, or other similar products, Thompson experience and "know-how" can effect substantial over-all savings in time, money, and materials. Write Thompson Products, Inc., WEST COAST PLANT, Bell, California.

Thompson Collector Ring Exhaust Port Flanges are being furnished for Douglas, Republic, Vought-Sikorsky, and Martin aircraft . . . and are used with the Pratt & Whitney R2800 engine—the largest of its type.

ARMY E NAVY

Thompson Products, Inc.

WEST COAST PLANT ★ BELL, CALIFORNIA

Source Material

For the information of readers, the following lists the periodicals, house organs, and other publications regularly received and reviewed.

The prices listed are for yearly subscriptions to recipients in the United States. Subscription prices to house organs are in many cases not available but may be obtained directly from the offices of the organization.

The AAFSATONIAN, School of Applied Tactics, Army Air Forces, Orlando, Fla.

The Ace-Pursuiter, Special Service Office, Paine Field, Everett, Wash.

Aero Digest, 515 Madison Ave., New York 22, N.Y., $3.00.

Aero News Letter, Aero Insurance Underwriters, 111 John St., New York 7, N.Y.

Aero Research Technical Notes, Aero Research Ltd., Duxford, Cambridge, England.

Aero Time, Basic Flying School, Army Air Forces, Gunter Field, Ala.

Aerodrome Abstracts, compiled by the Department of Scientific and Industrial Research and issued in collaboration with the Air Ministry, The Institution of Civil Engineers, St. George St., Westminster, London, S.W.1.

Aeronáutica, Avenida de Mayo 1370, Buenos Aires, Pesos 4.50.

Aeronáutica Argentina, Casilla de Correo 1897, Buenos Aires, Pesos 8.00.

Aeronautical Engineering Review, 1505 RCA Bldg. West, New York 20, N.Y., $3.00.

Aeronautics, Tower House, Southampton St., London, W.C.2, 27*s.*

Aeronca Wing Tips, Aeronca Aircraft Corp., 1712 Germantown Rd., Middletown, O.

The Aeroplane, Bowling Green Lane, London, E.C.1, 61*s.*

The Aeroplane Spotter, Bowling Green Lane, London, E.C.1, 8*s.* 8*d.*

Air Base News, Army Air Base, Jackson, Miss.

Air Currents, Army Air Field, Coffeyville, Kan.

Air Facts, 30 Rockefeller Plaza, New York 20, N.Y., $3.00.

Air Force, Army Air Forces, 101 Park Ave., New York 17, N.Y.

Air Force Review, 31 Willcocks St., Toronto, Canada, $3.00.

The Air Line Mechanic, 155 N. Clark St., Chicago 1, Ill.

The Air Line Pilot, 3145 W. 63rd St., Chicago 29, Ill.

Air Mail Magazine, Newport, Monmouthshire, England, 5*s.*

Air News, 545 5th Ave., New York 17, N.Y., $1.50.

Air Pilot and Technician, 515 Madison Ave., New York 22, N.Y., $3.00.

Air Tech, 545 5th Ave., New York 17, N.Y., $2.50.

Air Trails, 79 7th Ave., New York 11, N.Y., $2.50.

Air Transport, 330 W. 42nd St., New York 18, N.Y., $5.00.

Air Transportation, 10 Bridge St., New York 4, N.Y., $5.00.

Aircraft, 62 Flinders St., Melbourne, C.1, Australia, 16*s.*

Aircraft Engineering, 12 Bloomsbury Sq., London, W.C.1, 26*s.*

Aircraft Journal, United Aircraft Corp., E. Hartford, Conn.

Aircraft Production, Dorset House, Stamford St., London, S.E.1, £1. 14*s.* 6*d.*

The Aircraft Warning Volunteer, First Fighter Command, Army Air Forces, Mitchel Field, N.Y.

Aircraft-Age, 241 Church St., New York 13, N.Y., $1.20.

The AiResearcher, Airesearch Mfg. Co., Sepulveda Blvd., Los Angeles, Calif.

Airflow, Academy of Aeronautics, Jackson Heights, N.Y., and Casey Jones School of Aeronautics, Newark, N.J.

Airlanes, 340 W. 57th St., New York 19, N.Y., $2.50.

Air-O-Mech, Army Air Forces, Seymour Johnson Field, N.C.

Airpost Journal, Albion, Pa., $2.00.

Alamogordo Blockbuster, Army Air Base, Alamogordo, N.M.

Alert, Goodyear Tire & Rubber Co., Akron, O.

The Allis-Chalmers Operation and Maintenance Review, Allis-Chalmers Mfg. Co., Box 512, Milwaukee 1, Wis.

Allisonews, Allison Division, General Motors Corp., Indianapolis, Ind.

Aluminum News-Letter, Aluminum Co. of America, 801 Gulf Bldg., Pittsburgh 19, Pa.

AM, Army Air Field, Lincoln, Neb.

American Association for the Advancement of Science, Bulletin, Smithsonian Institution Bldg., Washington 25, D.C., $1.00.

American Aviation, 1317 F St., N.W., Washington 4, D.C., $3.00.

American Aviation Daily, 1317 F St., N.W., Washington 4, D.C., $170.00.

American Aviation Directory, 1317 F St., N.W., Washington 4, D.C., $7.50.

American Aviation Sky-Gest, American Aviation Corp., Jamestown, N.Y.

The American Mercury, 570 Lexington Ave., New York 22, N.Y., $3.00.

American Meteorological Society, Bulletin, Milton, Mass., $3.50.

The American Pilot and Aircraftsman, 225 S. Church St., Charlotte, N.C., $2.00.

American Society for Testing Materials, Bulletin, 260 S. Broad St., Philadelphia 2, Pa., $1.50.

American Society of Mechanical Engineers, Transactions, 29 W. 39th St., New York 18, N.Y., $12.

Anahuac, Tallers N. de C. A., Balbuena, D.F., México, $6.00 (Mex.).

Army News, Bureau of Public Relations, War Dept., Washington 25, D.C.

Army Ordnance, 705 Mills Bldg., Washington 6, D.C., $4.50.

Astronautics, 130 W. 42nd St., New York 18, N.Y., $3.00.

Automotive and Aviation Industries, Chestnut & 56th Sts., Philadelphia 39, Pa., $1.00.

Automotive News, 5229 Cass Ave., Detroit 2, Mich., $4.00.

Automotive War Production, Automotive Council for War Production, New Center Bldg., Detroit 2, Mich.

Avia, Belgrano 471, Piso 3°, Buenos Aires, Argentina, $6.00 *m/n.*

Aviação, R. Uruguiana 104, 4°, Rio de Janeiro, Brazil, *Rs.* 70$000.

Aviación, 416 W. 8th St., Los Angeles, Calif., $1.00.

Aviation, 330 W. 42nd St., New York 18, N.Y., $3.00.

Aviation and Yachting, 2816 Eaton Tower, Detroit 26, Mich., $2.00.

Aviation Equipment, 1170 Broadway, New York 1, N.Y.

Aviation Maintenance, 205 E. 42nd St., New York 17, N.Y., $5.00.

Aviation News, 330 W. 42nd St., New York 18, N.Y., $5.00.

Aviation Progress in Los Angeles County, Board of Supervisors of Los Angeles County, Los Angeles, Calif.

Aviation Service Magazine, 549 W. Washington Blvd., Chicago 6, Ill.

Aviation Writers Association, Newsletter, P.O. Box 856, Grand Central Annex, New York 17, N.Y.

Bakelite Review, Bakelite Corp., 30 E. 42nd St., New York 17, N.Y.

Barksdale's Bark, Army Air Forces, Barksdale Field, La.

The Beam, Basic Training Center, Army Air Forces, Fresno, Calif.

The Beam, Pilot School (Advanced Single Engine), Army Air Forces, Army Air Field, Marianna, Fla.

The Beam, Special Service Office, Army Air Forces, Bolling Field, D.C.

The Beech Log, Beech Aircraft Corp., Wichita, Kan.

The Bee-Hive, United Aircraft Corp., E. Hartford, Conn.

Bell Laboratories Record, 463 West St., New York 14, N.Y., $2.00.

The Bellringer, Bell Aircraft Corp., 2050 Elmwood Ave., Buffalo, N.Y.

Biggstuff, Army Air Forces, Biggs Field, Tex.

Black Landmarks, Blackland Army Air Field, Waco, Tex.

Bladesman, Propeller Div., Curtiss-Wright Corp., Caldwell, N.J.

Boeing Contact; Boeing Plane Talk, Boeing Airplane Co., Wichita, Kan.

Boeing News, Boeing Aircraft Co., Seattle, Wash.

The Bomb Bay, Army Air Forces, Hammer Field, Fresno, Calif., $2.00.

Bomb Blast, Army Air Field, Childress, Tex.

The Bombardier, Army Air Base, Pocatello, Ida.

Bombing Range High Score, Army Air Forces, Avon Park, Fla.

Bombs Away, Army Air Field, Victorville, Calif.

The Bombsight, Advanced Flying School, Army Air Forces, Kirtland Field, N.M.

Booster, Pilot School (Advanced Single Engine), Army Air Forces, Napier Field, Dothan, Ala.

Boot Hill Marauder, Army Air Field, Dodge City, Kan.

The Bradley Beam, Army Air Forces, Bradley Field, Conn.

Breeze American, Breeze Corporations, Inc., 41 S. 6th St., Newark, N.J.

Brewster Builder, Brewster Aeronautical Corp., 35th & Northern Blvd., Long Island City, N.Y.

Britain, British Information Services, 30 Rockefeller Plaza, New York 20, N.Y., $1.00.

British Airways News Letter, British Overseas Airways Corp., Airways House, London, S.W.1.

Bulaero, Curtiss-Wright Technical Institute, Glendale, Calif.

Bulletin of Technical Data for the Plywood Industry, The Resinous Products & Chemical Co., 222 W. Washington Sq., Philadelphia 5, Pa.

Bulletin of War Medicine, British Information Services, 30 Rockefeller Plaza, New York 20, N.Y., $4.50.

The Cactus, Army Air Field, Kingman, Ariz.

Caminos del Aire, Pan American Airways, Bolivar 18, México, D.F.

Canadian Air Cadet, 122 Wellington St., Ottawa, $1.00.

Canadian Aviation, 481 University Ave., Toronto 2, $2.50.

Canadian Car Journal, Canadian Car & Foundry Co., Ltd., 621 Craig St., West, Montreal, Quebec.

The Carrier, Army Air Forces, Bowman Field, Louisville, Ky.

Cessquire, Cessna Aircraft Co., Wichita, Kan.

The Chance Vought News, Chance Vought Aircraft Div., United Aircraft Corp., Stratford, Conn.

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1919—BUILDERS OF DEPENDABLE AIRCRAFT ENGINES FOR A QUARTER CENTURY—1944

Chicago Airview News, Douglas Aircraft Co., Inc., Chicago, Ill.

Chinese Institute of Engineers, Journal, 119 W. 57th St., New York, N.Y., $1.00.

Circle-News, The B. F. Goodrich Co., Akron, O.

Civil Aeronautics Journal, U.S. Government Printing Office, Washington 25, D.C., $0.50.

Civil Air Patrol Bulletin, Office of Civilian Defense, Washington 25, D.C.

Civil Air Patrol Bulletin, Wisconsin Wing 62, Civil Air Patrol, 110 E. Wisconsin Ave., Milwaukee, Wis.

Civil Air Patrol Courier, Missouri Wing 73, Civil Air Patrol, Kratz Field, St. Louis, Mo.

Cockpit Clatter, Aircraft Owners and Pilots Assn., Carpenters Bldg., Washington 1, D.C.

Colliers, The Crowell-Collier Publishing Co., Springfield, O., $3.00.

Columbia Aircast, Columbia Aircraft Products, Inc., Haynes St., Somerville, N.J.

The Comet, Ampco Metal, Inc., Milwaukee 4, Wis.

Command Post, Air Service Command, McClellan Field, Sacramento, Calif.

Commercial Aviation, 919 Tramways Bldg., Montreal, Quebec, $3.00.

The Common-Ader, Plant 2, Commonwealth Aircraft, Inc., Kansas City, Mo.

Construction Glues, I. F. Laucks, Inc., 911 Western Ave., Seattle, Wash.

Contact, Air Lines Terminal Bldg., New York 17, N.Y., $2.00.

Contact, Michigan Wing 63, Civil Air Patrol, 2310 Book Tower, Detroit, Mich.

The Continental Eagle, Continental Air Lines, Inc., Denver, Colo.

Convair News, Consolidated Vultee Aircraft Corp., Miami, Fla.

Craig Field Journal, Pilot School (Advanced Single Engine), Army Air Forces, Craig Field, Selma, Ala.

The Cub Flier, Piper Aircraft Corp., Lock Haven, Pa.

Current Aviation, 400 S. Front St., Columbus 15, O., $0.80.

Curtiss Fly-Leaf, Curtiss-Wright Corp., Municipal Airport, Buffalo, N.Y.

Curtiss-Wright-er, Curtiss-Wright Corp., Lambert Field, St. Louis, Mo.

Daggett Airview News, Douglas Aircraft Co., Inc., Daggett, Calif.

The Dalhart Bomber, Army Air Base, Dalhart, Tex.

Del Valle News, Bergstrom Army Air Field, Austin, Tex.

Diesel Power & Diesel Transportation, 192 Lexington Ave., New York 16, N.Y., $3.00.

Domestic Commerce, U.S. Government Printing Office, Washington 25, D.C., $1.00.

Douglas Airview, Douglas Aircraft Co., Inc., Santa Monica, Calif.

Dow Diamond, The Dow Chemical Co., Midland, Mich.

The Draftsman, 171 Madison Ave., New York 16, N.Y., $3.00.

The Dragon, The Fafnir Bearing Co., New Britain, Conn.

Drew Field Echoes, Army Air Base, Drew Field, Tampa, Fla.

The Eagle, Consolidated Vultee Aircraft Corp., Ft. Worth, Tex.

The Eagle Eye, Eagle Pass Army Air Field, Eagle Pass, Tex.

Eastern Aircraftsman, Eastern Aircraft Div., General Motors Corp., Linden, N.J.

The Eaton News, Eaton Mfg. Co., 739 E. 140th St., Cleveland, O.

The Edo Log, Edo Aircraft Corp., College Point, N.Y.

El Segundo Airview News, Douglas Aircraft Co., Inc., El Segundo, Calif.

Electrical Engineering, 33 W. 39th St., New York 18, N.Y., $12.00.

The Engineer, 28 Essex St., Strand, London, W.C.2, £3. 3*s.*

The Engineers' Digest, 1 Madison Ave., New York 10, N.Y., $7.50.

Enid Plane Facts, Enid Army Flying School, Enid, Okla.

The Exchangite, 335 Superior St., Toledo, O., $1.00.

Facts and Features, Office of War Information, Washington 25, D.C.

FAD, Fairchild Aircraft Division, Fairchild Engine and Airplane Corp., Hagerstown, Md.

The Faircrafters, Fairchild Aircraft Div., Fairchild Engine and Airplane Corp., Burlington, N.C.

Flagship News, American Airlines, Inc., New York Municipal Airport, Jackson Heights, N.Y.

Fleetwings' Arrow, Fleetwings Division, Kaiser Cargo, Inc., Bristol, Pa.

Flexigun, Flexible Gunnery School, Army Air Forces, Ft. Myers, Fla.

Flight, Dorset House, Stamford St., London, E.C.1, £3. 1*s.*

Flight Control, Eclipse-Pioneer Division, Bendix Aviation Corp., Teterboro, N.J.

The Flight Pattern, Army Air Field, Douglas, Ariz.

Flight Time, Basic Pilot School, Army Air Forces, Goodfellow Field, Tex.

Flyer, Army Air Base, Reno, Nev.

The Flyer, Army Air Field, Chico, Calif.

Flying Aces, 67 W. 44th St., New York 18, N.Y., $1.00.

Flying Cadet, 420 Lexington Ave., New York 17, N.Y., $1.00.

The Flying M, Menasco Mfg. Co., 805 S. San Fernando Blvd., Burbank, Calif.

Flying Time, Pilot School (Basic), Army Air Forces, Pecos, Tex.

Flying Time, South Plains Army Air Field, Lubbock, Tex.

Flying Vistas, Cessna Aircraft Co., Wichita, Kan.

Foster Field Fighter, Army Air Forces, Foster Field, Tex.

The Foundation, The Engineering Society of Detroit, 100 Farnsworth Ave., Detroit, Mich.

Franklin Institute, Journal, Benjamin Franklin Pkwy. at 20th St., Philadelphia, Pa., $6.00.

General Aircraft News, London Air Park, Feltham, Middlesex, England.

Global Service Log, Lockheed Aircraft Corp., Burbank, Calif.

Globe Beam, Globe Aircraft Corp., North Side Station, Ft. Worth, Tex.

GM Folks, General Motors Corp., Detroit, Mich.

Great Britain, Aeronautical Research Committee, Reports and Memoranda, British Information Services, 30 Rockefeller Plaza, New York 20, N.Y.

Great Britain, Ministry of Aircraft Production, Translations, The Secretary (R.T.P. 3), Millbank, London, S.W.1.

The Greenwood Gremlin, Pilot School (Basic), Army Air Forces, Greenwood, Miss.

The Gulfport Field Post, Army Air Forces, Gulfport Field, Miss.

Hags Howl, Flexible Gunnery School, Army Air Forces, Harlingen, Tex.

Hamilton Field Takeoff, Army Air Forces, Hamilton Field, Calif.

Hangar Flying, Lockheed Aircraft Corp., Burbank, Calif.

Haul Down and Ease Off, National Association of American Balloon Corps Veterans, P.O. Box 2040, Wichita, Kan.

Hawk's Cry, Army Air Field, Tuskegee, Ala.

Heath Beacon, Heath Co., Benton Harbor, Mich.

The Hecker Michronicle, A. W. Hecker, 1976 E. 66th St., Cleveland, O.

High Pressure, Walter Kidde & Co., 140 Cedar St., New York 6, N.Y.

The Hillfielder, Air Service Command, Hill Field, Ogden, Utah.

Hobart Arc Welding News, Hobart Brothers Co., Troy, O.

Inco, The International Nickel Co., Inc., 67 Wall St., New York 5, N.Y.

Indian Aviation, 13 Ezra Mansions, P.O. Box 2361, Calcutta, India, *Rs.* 7/8.

Institute of Transport, Journal, 15 Savoy St., London, W.C.2, 10*s.* 4*d.*

Institute of Welding, Transactions, 2, Buckingham Palace Gardens, London, S.W.2, 32*s.*

The Intava World, International Aviation Associates, Artillery House, Artillery Row, London, S.W.1.

Interstate-ments, Interstate Aircraft and Engineering Corp., 3443 Wilshire Blvd., Los Angeles, Calif.; DeKalb, Ill.

The Iron Age, 100 E. 42nd St., New York 17, N.Y., $8.00.

Jefferson Barracks Hub, Air Forces Basic Training Center, Jefferson Barracks, Mo.

Journal of Applied Mechanics, 29 W. 39th St., New York 18, N.Y., $5.00.

Journal of Aviation Medicine, 2642 University Ave., St. Paul, Minn., $5.00.

Journal of Research of the National Bureau of Standards, U.S. Government Printing Office, Washington 25, D.C., $3.50.

Journal of Scientific Instruments, The University, Reading, Berkshire, England, 33*s.*

Journal of the Aeronautical Sciences, 1505 RCA Bldg. West, New York 20, N.Y., $7.00.

The Keesler Field News, Eastern Technical Training Command, Army Air Forces, Biloxi, Miss.

The LAAF Aileron, Army Air Field, Lemoore, Calif.

The Learavian, Lear Avia, Piqua, O.

Library Bulletin of Abstracts, Universal Oil Products Co., 310 S. Michigan Ave., Chicago, Ill.

The Lockbourne Air Base News, Lockbourne Army Air Base, Columbus, O.

The Lockheed Aircraftsman; The Lockheed Star, Lockheed Aircraft Corp., Burbank, Calif.

The Log, Army Air Field, Lake Charles, La.

Long Beach Airview News, Douglas Aircraft Co., Inc., Long Beach, Calif.

The Lukominique, Army Air Forces, Luke Field, Ariz.

The Lycoming Star, Lycoming Div., Aviation Corp., Williamsport, Pa.

McDonnell Bulletin, McDonnell Aircraft Corp., Lambert Field, St. Louis, Mo.

The M.A.A.F. Cowling, Marana Army Air Field, Tucson, Ariz.

Machine Tools, National Machine Tool Builders Assn., Cleveland, O.

The March Field Beacon, Army Air Forces, March Field, Calif.

Marfacts, Pilot School (Advanced Two Engine), Army Air Forces, Marfa, Tex.

The Martin Star, The Glenn L. Martin Co., Baltimore 3, Md.

MechaNews, The Ewing Publishing Co., Amarillo, Tex.

Mechanical Engineering, 29 W. 39th St., New York 18, N.Y., $6.00.

Mechanical Topics, The International Nickel Co., Inc., 67 Wall St., New York 5, N.Y.

Mechanix Illustrated, 1501 Broadway, New York 18, N.Y., $1.50.

Metals and Alloys, 330 W. 42nd St., New York 18, N.Y., $2.00.

Metco News, Metallizing Engineering Co., Inc., 38-14 30th St., Long Island City, N.Y.

The Military Surgeon, Army Medical Museum, Washington 25, D.C., $4.00.

Model Airplane News, 551 5th Ave., New York 17, N.Y., $2.00.

Model Aviation, Air Youth Division, National Aeronautic Assn., 1025 Connecticut Ave., Washington 6, D.C., $1.00.

Modern Plastics, 122 E. 42nd St., New York 17, N.Y., $5.00.

Modern Transport, 105 Strand, London, W.C.2, 20*s.*

The Monthly Honker, Canadian Pacific Air Lines, 620 Dominion Sq. Bldg., Montreal, Quebec.

Monthly Science News, 3 Hanover St., London, W.1.

Monthly Weather Review, U.S. Government Printing Office, Washington 25, D.C., $2.00.

Mundo Aeronáutico, Rivadavia 945, Buenos Aires, Argentina, Pesos 4.00.

NAAF News, Army Air Field, Newport, Ark.

National Aeronautics, 1025 Connecticut Ave., Washington 6, D.C., $3.00.

The N.A.T.A. Dispatch, National Aviation Training Assn., 214 E. Armour Blvd., Kansas City, Mo.

New Horizons, Pan American Airways System, 135 E. 42nd St., New York 17, N.Y.

New York University, Contributions from the College of Engineering, University Heights, New York 53, N.Y.

News, Army Air Field, Presque Isle, Me.

News Digest, Hill & Knowlton, 350 5th Avenue, New York 1, N.Y.

Nickel Cast Iron News; Nickel Steel Topics, The International Nickel Co., Inc., 67 Wall St., New York 5, N.Y.

Noorduyn Tale-Spin, Noorduyn Aviation Ltd., 1411 Crescent St., Montreal, Quebec.

North American Skyline; North American Skywriter, North American Aviation, Inglewood, Calif.

North Ameri-Kansan, North American Aviation, Fairfax, Kansas City, Kan.

Northeast Airlines Gremlin; The Northeast Airlines Up-to-the-Minute Man, Northeast Airlines, Inc., Commonwealth Airport, Boston, Mass.

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The Northern Dispatch, Army Air Base, Great Falls, Mont.

The Northrop News, Northrop Aircraft, Inc., Hawthorne, Calif.

Notam, Army Air Base, Daniel Field, Augusta, Ga.

The Official Foreign Air Mail Guide, 11 W. 42nd St., New York 18, N.Y., $1.50.

The Official Guide of the Airways, 608 S. Dearborn Ave., Chicago 5, Ill., $5.00.

Ohio State University, Engineering Experiment Station News, Columbus, O.

Oklahoma City Douglas Airview News, Douglas Aircraft Co., Inc., Oklahoma City, Okla.

Pacific Plastics, 1151 S. Broadway, Los Angeles 15, Calif., $3.00.

Parks Air News, Parks Air College, Inc., Parks Airport, East St. Louis, Ill.

The Pegasus, Fairchild Engine and Airplane Corp., 30 Rockefeller Plaza, New York 20, N.Y.

Pesco News, Pesco Products Co., 11610 Euclid Ave., Cleveland 6, O.

The Pick-Up, All American Aviation, Inc., 209 W. 9th St., Wilmington, Del.

Picture News, Sinclair Refining Co., 101 W. 51st St., New York 19, N.Y.

The Pilot, Army Air Field, La Junta, Calif.

The Pilot, Army Air Field, Walnut Ridge, Ark.

Plane Talk, Consolidated Vultee Aircraft Corp., 350 5th Ave., New York 1, N.Y.

Planetoid, The Denver Planning Commission, Denver, Colo.

Plastics Bulletin, E. I. Du Pont de Nemour & Co., Inc., Arlington, N.J.

The Polar Tech, The Argus-Leader Co., Sioux Falls, S.D.

Popular Mechanics Magazine, 200 E. Ontario St., Chicago 11, Ill., $2.50.

Popular Science Monthly, 353 4th Ave., New York 10, N.Y., $2.00.

Prairie Flier, Strother Army Air Field, Winfield, Kan.

Production and Engineering Bulletin, British Supply Council in North America, P.O. Box 680, Benjamin Franklin Station, Washington, D.C.

Production Drive Committee News, North American Aviation, Inglewood, Calif.

Production Equipment, 328 S. Jefferson St., Chicago 6, Ill.

Production Improvement Bulletin, Airplane Div., Curtiss-Wright Corp., Municipal Airport, Buffalo, N.Y.

Production Information, Automotive Council for War Production, New Center Bldg., Detroit 2, Mich.

Quarterly of Applied Mathematics, Brown University, Providence 12, R.I., $6.00.

The Randolph Rookie, Army Air Forces, Randolph Field, Tex.

Ranger's Cloud Buster, Ranger Aircraft Engines Div., Fairchild Engine and Airplane Corp., Farmingdale, N.Y.

Recent Periodical Articles, Library, Parks Air College, Inc., Parks Airport, East St. Louis, Ill.

The Reflector, Army Air Base, Richmond, Va., $2.00.

Republic Aviation News, Republic Aviation Corp., Farmingdale, N.Y.

The Resinous Reporter, The Resinous Products & Chemical Co., 222 W. Washington Sq., Philadelphia 5, Pa.

The Rev Meter, Army Air Forces, Lowry Field, Denver, Colo.

Revista Aérea Latino Americana, 515 Madison Ave. New York 22, N.Y., $1.00.

Revista de Aeronáutica, Ministerio del Aire, Juan de Mena 8, Madrid, 100 Pesetas.

Revista de la Fuerza Aérea, Ministerio de Defensa Nacional, El Bosque, Santiago de Chile.

Revista do Ar, Aero Clube de Portugal, Avenida da Liberdade 226, Lisboa, 72$00.

The Robins Field News, Army Air Base, Robins Field, Warner Robins, Ga.

Roger, 6th Ferrying Group, Air Transport Command, Army Air Field, Long Beach, Calif.

The Rohm & Haas Reporter, Rohm & Haas Co., 222 W. Washington Sq., Philadelphia 5, Pa.

Rotol Digest, Technical Library, Rotol Ltd., Gloucester, England.

The Royal Aeronautical Society, Journal, 4, Hamilton Place, London, W.1, £3. 3s.

The Runway, Army Air Forces, Pope Field, Ft. Bragg, N.C.

Ryan Flying Reporter, Ryan Aeronautical Company, San Diego, Calif.

The Salt Tablet, Army Air Base, Wendover Field, Utah.

Salvo, Army Air Base, Roswell, N.M.

Santa Monica Airview News, Douglas Aircraft Co., Inc., Santa Monica, Calif.

The Saturday Evening Post, Independence Square, Philadelphia 5, Pa., $3.00.

Schweizer Aero-Revue, Schanzenstrasse 1, Bern, Switzerland, Sw. Fr. 10.00.

Scientific American, 24 W. 40th St., New York 18, N.Y., $4.00.

Selfridge Field News, Army Air Forces, Selfridge Field, Ala.

Service Engineering, Kent-Moore Organization, Inc., 485 W. Milwaukee Ave., Detroit, Mich.

Sheet Metal Industries, 49 Wellington St., Strand, London, W.C.2, 10s.

Shell Progress, Shell Oil Co., 50 W. 50th St., New York 20, N.Y.

Sheppard Field Texacts, Army Air Forces Technical School, Sheppard Field, Tex.

Simmonds Aeronews, Simmonds Aerocessories, Inc., 21-10 49th Ave., Long Island City, N.Y.

Sky Steps, Chicago and Southern Air Lines, Municipal Airport, Memphis 2, Tenn.

Skyways, 30 Rockefeller Plaza, New York 20, N.Y., $3.00.

The Slip Stream, Army Air Base, Casper, Wyo.

SNAFU, Eastern Flying Training Command, Army Air Forces, George Field, Ill., $0.05 per copy.

Snaproll, Pilot School (Basic), Army Air Forces, Minter Field, Bakersfield, Calif.

Soaring, P.O. Box 71, Elmira, N.Y., $2.00.

Sociedad Cubana de Ciencias Físicas y Matemáticas, Revista, Universidad de la Habana, Habana, Cuba, $3.00.

S.A.E. Accelerator; S.A.E. Journal, 29 W. 39th St., New York 18, N.Y., $10.

S.B.A.C. Press Summary, Society of British Aircraft Constructors, 32 Saville Row, London, W.1.

The Solar Blast, Solar Aircraft Co., Lindbergh Field, San Diego, Calif.

Southern Flight, 1901 McKinney Ave., Dallas, Tex., $2.00.

Spartan School News, Spartan School of Aeronautics, Municipal Airport, Tulsa, Okla.

The Sperry News; The Sperryscope, Sperry Gyroscope Co., Manhattan Bridge Plaza, Brooklyn 1, N.Y.

The Stabilizer, The Lincoln Electric Co., Coit Rd. & Kirby Ave., Cleveland, O.

Steel Horizons, Allegheny Ludlum Steel Corp., Brackenridge, Pa.

Steel Processing, 108 Smithfield St., Pittsburgh 30, Pa., $2.00.

The Stewart-Warner Worker, Stewart-Warner Corp., 1827 W. Diversey Pkwy., Chicago, Ill.

Stinson Field Weekly Bulletin, Air Depot Training Station, Stinson Field, San Antonio, Tex.

The Stinsonair, Stinson Division, Consolidated Vultee Aircraft Corp., Wayne, Mich.

Tac, Tactical Center, Army Air Forces, Orlando, Fla.

Tail Skid, Army Air Forces, Lawson Field, Ga.

Tailspin, Army Air Forces, Ellington Field, Houston, Tex.

Take-Off, Farris Publishing Co., Tinker Field, Okla.

Take-Off, North American Aviation, Dallas, Tex.

The Tale-Spinner, Army Air Forces Preflight School, San Antonio, Tex.

The Tarranter, Army Air Field, Ft. Worth, Tex.

The Taylorcraft News, Taylorcraft Aviation Corp., Alliance, O.

Technical Data Digest, Matériel Center, Engineering Division, Army Air Forces, Wright Field, Dayton, O.

Technical Education News, McGraw-Hill Publishing Co., 330 W. 42nd St., New York 18, N.Y.

Technical News Bulletin of the National Bureau of Standards, U.S. Government Printing Office, Washington 25, D.C., $0.50.

10-Shun, Eastern Technical Training Command, Army Air Forces, Greensboro, N.C.

Texaco Star, The Texas Co., 135 E. 42nd St., New York 17, N.Y.

Texacts, Army Air Forces Technical School, Sheppard Field, Tex.

Thiokol Facts, Thiokol Corp., Trenton, N.J.

Thunderbird, The Rapid City Journal, Rapid City, S.D.

To Keep 'Em Flying, Miami Beach Daily Tropics, Miami Beach, Fla.

Torque Tattle, Army Air Forces, Cochran Field, Ga.

Trade Winds, Wright Aeronautical Corp., Paterson, N.J.

Trade-A-Plane Service, Crossville, Tenn.

Transatlantic Air News, American Export Airlines, 25 Broadway, New York 4, N.Y.

The T.W.A. Skyliner, Transcontinental & Western Air, Inc., 10 Richards Rd., Kansas City, Mo.

True Drift, Army Air Forces, Selman Field, La.

Tucumán, Universidad Nacional, Revista, Serie A, Matemáticas y Física Teórica, Ayacucho 482, Tucumán, Argentina.

Tulsa Airview News, Douglas Aircraft Co., Inc. Tulsa, Okla.

The Twin Prop, Pilot School (Advanced Two Engine), Army Air Forces, Stockton Field, Calif.

The Twin Spinner, Army Air Field, Altus, Okla.

Twingine Times, Pilot School (Advanced Twin Engine), Freeman Army Air Field, Seymour, Ind.

United Air Lines News, United Air Lines Corp., 5959 S. Cicero Ave., Chicago, Ill.

U. S. Air Services, Transportation Bldg., Washington 6, D.C., $3.00.

U. S., N.A.C.A., Technical Memorandums, National Advisory Committee for Aeronautics, Washington 25, D.C.

U. S. Steel News, U. S. Steel Corp., 436 7th Ave., Pittsburgh, Pa.

Universal Airline Schedules, 1317 F St., N.W., Washington 4, D.C., $5.00.

Universal Engineering Digest, Universal Trading Corp., 630 5th Ave., New York, N.Y.

Upcheck, Lewis School of Aeronautics, Lockport, Ill., $3.00.

V.D.I. Zeitschrift, Edwards Brothers, Inc., 300 John St., Ann Arbor, Mich., $19.

The Volunteer, Nashville Div., Consolidated Vultee Aircraft Corp., Nashville, Tenn.

Vox Prop, Air Service Command, Army Air Field, Rome, N.Y.

Vox Prop, American Propeller Corp., Toledo, O.

The Waco Word, Waco Aircraft Co., Troy, O.

War Medicine, 535 N. Dearborn St., Chicago 10, Ill., $6.00.

War Production Drive, Summerill Tubing Co., Bridgeport, Montgomery County, Pa.

Warplane Production, Aircraft War Production Council, Inc., Hollywood Professional Building, Los Angeles 28, Calif.

Washington News Letter, 1025 Connecticut Ave., Washington 6, D.C., $2.00.

The Wasp Nest, Pratt & Whitney Aircraft Div., United Aircraft Corp., Kansas City, Mo.

Weight Engineering, Society of Aeronautical Weight Engineers, Inc., 143 N. Brand Blvd., Glendale 3, Calif., $1.75.

The Welding Journal, 33 W. 39th St., New York 18, N.Y., $5.00.

West Coast Air Mail Society, Bulletin, 4142 26th St., San Francisco 14, Calif.

Western Flying, 304 S. Broadway, Los Angeles 13, Calif., $2.00.

Wheelco Comments, Wheelco Instruments Co., Harrison & Peoria Sts., Chicago 7, Ill.

Williams Field Airfax, Army Air Forces, Williams Field, Chandler, Ariz.

Wing Tips, Army Air Field, San Bernardino, Calif.

Wing Tips, Pilot School (Specialized Two Engine), Mather Field, Sacramento, Calif.

Wings, McGraw-Hill Publishing Co., 330 W. 42nd St., New York 18, N.Y.

Wings, 1-5 Marion St., Wellington, N.Z., 10s.

Wingspread, Army Air Forces, Peterson Field, Colorado Springs, Colo.

Wing-Tips, Waco Army Flying School, Waco, Tex.

Wright at the Moment, Wright Aeronautical Corp., Paterson, N.J.

Yuma Actioneer, Army Air Field, Yuma, Ariz.

Zoom, Basic Flying School, Army Air Forces, Bainbridge, Ga.

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Government Publications

Army Air Forces

Report of the Commanding General of the Army Air Forces to the Secretary of War. The 54 pages of text matter included in this report are divided into sections as follows: before Pearl Harbor, building an air force, combat operations, and the men. It gives a thorough review of the activities of the Air Forces, the obstacles that were overcome, and the accomplishments of the various units.

Following the text matter, there is a list of the dates of activation of the different Air Forces and of their commanding officers, followed by a map showing the locations and routes of the transport commands and graphs showing the growth in personnel and equipment and the organization of the Air Forces.

High Altitude Frostbite. Loyal Davis, John E. Scarff, Neil Rogers, and Meredith Dickinson. A preliminary report on cold damage to the extremities suffered by high-altitude airmen has been reprinted from *Surgery, Gynecology and Obstetrics*, December, 1943. It is pointed out that such cold damage differs from the common frostbite as greatly as the "Bird's Eye" frozen foods differ from cold storage foods. Clinical types of high-altitude frostbite are described and illustrated. The pathology of the subject is discussed. *Aero-Medical Laboratory*, Wright Field.

Atlantic Crossing in a Ju88. Major Warner E. Newby. An account is given of how two Army Air Forces officers flew a captured Ju 88 across the ocean for inspection by Matériel Command engineers. Some information is furnished about the plane, which is a twin-engined, high-altitude medium bomber equipped with a special camera installation for taking photographs 5 miles above the earth. Problems encountered in operating the plane and making the long flight are described. Little information about the plane was available because it was so new. Difficulties experienced in overhauling the engines and plane and preparing it for the trip across the ocean are outlined. It is stated that it took 2½ days to remove the spark plugs for cleaning, and the mechanics had to design special tools for the purpose. Facts learned about the plane's offensive power are given. At a sacrifice in range, two 1,000-lb. bombs could be slung under the wings so that the plane could be used as a high-altitude bomber. A unique gun-rack arrangement permitted the use of six 0.303-caliber machine guns for ground attack and strafing. Problems connected with the installation of additional fuel tanks are described. Information on the performance of the plane gained in the flight across the ocean is listed and discussed. *Air Force*, January, 1944.

Flak Helmets. A report describes two new and improved "flak" helmets developed by the Army Air Forces Matériel Command working in conjunction with the Small Arms Branch of the Ordnance Technical Division. It is stated that the M-1 steel helmets that were being used did not provide sufficient protection to the neck and face. The new helmets are designed to give protection, comfort, and freedom of movement. The M-4 model fits over all standard headdress and equipment worn by both Army and Navy airmen.

It covers a pilot's earphones, microphone, oxygen mask, goggles, and head covering. The helmet features, a "suspended design" that rests it firmly and comfortably high on the man's head so as not to interfere with any of his other equipment. An adjustable system of straps and buckles makes it easy for the wearer of the helmet to make necessary adjustments. Of rather square design, it covers the head, forehead, neck, and ears and will resist shell fragments caused by the explosion of the flak shells. The M-5 is a rounded adaptation of the M-4 for use in restricted turrets and where space is insufficient to wear the larger M-4 type. *A.A.F. Matériel Command*, Wright Field.

The Principles of War. Brig. Gen. Ralph F. Stearley. In this article it is stated that there are nine fundamental principles of war in the air. These are the principles of cooperation, objective, offensive, mass, movement, economy, suprise, security, and simplicity. An easy way to remember these principles is suggested. Sections of the article briefly discuss each of the nine principles. *Air Force*, January, 1944.

Organization Chart Army Air Forces. A revised organization chart of the Army Air Forces has been published. It is dated November 15, 1943, and shows the different divisions of the service and the officers in command. *Air Force*, January, 1944.

Don't Drop Them Too Soon. Lt. W. A. Byrne. A description is given of wing-tank tests carried out at the Army Air Forces Proving Ground, Eglin Field, Fla. A "wind machine" was used to create a wind speed of 90 to 120 m.p.h. Tanks containing 100-octane gasoline were suspended in this air stream and subjected to the fire from a 0.50-caliber machine gun. The results of the tests are outlined. *Air Force*, January, 1944.

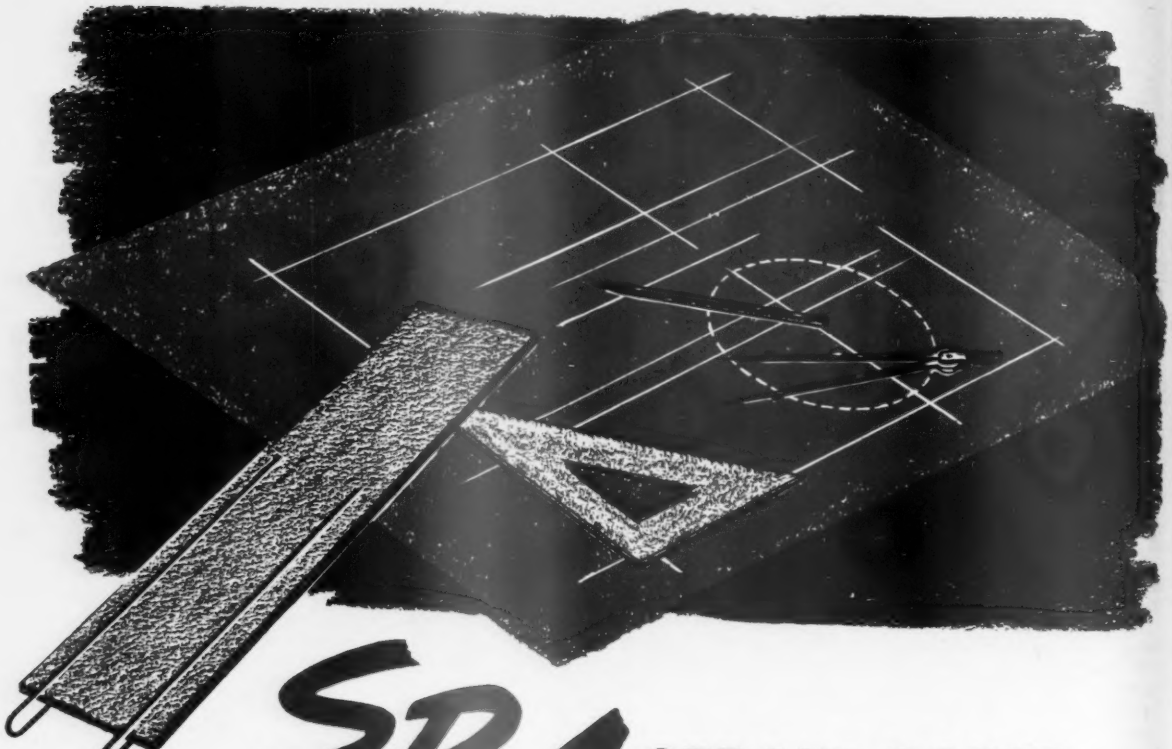
Ingenuity in Artificial Respiration. Peter V. Karpovich. Methods of carrying out artificial respiration under adverse conditions are described. It is explained that it often is impossible or impracticable to use the usual methods of artificial respiration because of lack of space, as for example, when the victim is on a crowded life raft. The primary consideration is to accomplish inflation and deflation of the lungs. Just how this is accomplished is not so important. Methods of artificial respiration employed under unusual circumstances are described. *Air Force*, January, 1944.

Bureau of Aeronautics, U.S. Navy

Air Masses and Fronts. A 34-page booklet constituting No. 4 of the "Aerology Series" contains an outline in everyday language of the basic causes of weather conditions. Intended for trainees, this booklet gives information on meteorology as applied to the upper air. A glossary is provided of terms used in the booklet. *Training Division, Bureau of Aeronautics*, $0.10.

National Advisory Committee for Aeronautics

Turbulent Friction in the Boundary Layer of a Flat Plate in a Two-Dimensional Compressible Flow at High Speeds. F. Frankel and V. Voishel. (Report No. 321, of the Central Aero-Hydrodynamical Institute, Moscow, 1937.) In this report an investigation is made, on a flat plate in a two-dimensional compressible flow, of the effect of compressibility and heating on the turbulent frictional drag coefficient in the boundary layer of an airfoil or wing radiator. The analysis is based on the Prandtl-Kármán theory of the turbulent boundary layer and the Stodola-Crocco theorem on the linear relation between the total energy of the flow and its velocity. Formulas are



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obtained for the velocity distribution and the frictional drag law in a turbulent boundary layer with the compressibility effect and heat transfer taken into account. It is found that with increase of compressibility and temperature at full retardation of the flow (the temperature when the velocity of the flow at a given point is reduced to zero in case of an adiabatic process in the gas) at a constant value of log R_x, the frictional drag coefficient c_f decreases, both of these factors acting in the same sense. *N.A.C.A. T.M. No. 1053*, December, 1943.

Heat Transfer and Hydraulic Flow Resistance for Streams of High Velocity. V. L. Lelchuk. (Translation received from Massachusetts Institute of Technology, from *Jour. Tech. Phys.* (U.S.S.R.), Vol. IX, No. 9, 1939.) Problems of hydraulic flow resistance and heat transfer for streams with velocities comparable with acoustic velocities have great importance for various fields of technical science. Especially, they have great importance for the field of heat transfer in designing and constructing boilers of the "Velox" type. In this article a description of experiments and their results with regard to definition of the laws of heat transfer in differential form for high velocity air streams inside smooth tubes are given. *N.A.C.A. T.M. No. 1054*, December, 1943.

Piston Ring Pressure Distribution. M. Kuhn. (Translation from *A.T.Z. Automobiltechnische Zeitschrift*, Vol. 45, No. 3, February 10, 1942, pages 62–67, taken from *The Engineers' Digest*, Vol. 111, No. 11, November, 1942.) Pressure distribution in piston rings is discussed in sections dealing with the development of the material for the rings, manufacturing processes, ring stressing, the stress distribution pattern, the measurement of pressure distribution, and applications. *N.A.C.A. T.M. No. 1056*, December, 1943.

Civil Aeronautics Administration

Annual Survey by Administrator. Increased attention to postwar planning featured civil aviation developments in 1943, according to a year-end review issued by Charles I. Stanton, Administrator of Civil Aeronautics. Air-line service to small cities, new and better air-traffic control devices, and a greatly enlarged airport system are among the postwar possibilities explored. Major activities of the C.A.A. in 1943 necessarily were devoted to projects directly serving the armed forces. These included the $400,000,000 defense airport program; operation of a 35,000-mile airway system on which 85 per cent of the traffic was military; engineering, factory, and flight inspection of military transports and other noncombat planes; and flight training of more than 200,000 men for the Army and Navy.

The C.A.A. airport program during 1943 increased the number of United States landing fields suitable for transport aircraft from 660 to 940. The number of such fields at the end of 1940, when the C.A.A. program was launched, was 94. In all categories, the United States now has about 3,000 airports, compared with approximately 2,500 two years ago. For the early postwar years, Mr. Stanton estimated a need for double our present number of airports. A total of 6,000 fields might cost approximately $800,000,000, an expenditure equal to the entire present investment in United States airports. A Federal-aid system of financing such construction was proposed similar to the procedure followed in road building.

Traffic along the Federal airways built and maintained by C.A.A. increased heavily, largely because of military activity. There were 16,277,027 aircraft operations reported in 1943 to the C.A.A. centers that control traffic on these aerial highways, compared with 9,208,776 operations reported in 1942. As traffic began to approach capacity on certain busy sectors of the airways, C.A.A. personnel intensified the study of new control devices, including electrical boards for automatic posting of flight progress reports; omnidirectional radio markers, which send out signals in all directions as distinct from conventional radio-range stations which emit signals in four set courses for planes to follow; and electronic anticollision devices by which pilots will be able to see on the instrument panel the location of all planes within the danger zone around them.

Despite heavier loading and greater utilization of air-line planes, safety records grew. Number of miles flown per fatal accident in domestic air carrier operations reached an all-time high of 46,560,835 in 1943, against 22,020,572 in 1942.

During 1943 more than 10,000 new aircraft were inspected at the factory by C.A.A. representatives, flight-tested, or both. Airmen examined for certificates of competency included more than 18,000 would-be private pilots, 15,000 commercial pilots, 9,500 flight instructors, and 9,000 engine mechanics.

The C.A.A. War Training Service gave approximately 250,000 flight courses during 1943 to Army and Navy cadets. Part of this increase over the 1942 total of 70,000 can be attributed to the inauguration of C.A.A. 10-hour flight indoctrination courses for all Army cadets during their college training. Previous C.A.A. courses had been at least 35 hours in length. Full-length elementary courses continued to be given in 1943 to about 25,000 Navy cadets, and full-length elementary and advanced courses were given to 7,000 members of the Army slated for duty as instructors or service pilots.

The number of pilots holding C.A.A certificates increased from 110,510 in 1942 to 124,050 in 1943. This increase includes both new military pilots who chose to obtain civilian certificates and civilians who trained for essential flying jobs such as instructors or members of the Civil Air Patrol.

Air-line activities increased despite the fact that by the beginning of 1943 the Army had requisitioned about half of the 359 planes in prewar service. Through fuller loading and more intensive use of the remaining planes, revenue passenger-miles rose from 1,398,024,146 in 1942 to 1,505,264,230 in 1943; air express, from 40,102,000 pounds in 1942 to 61,366,000 in 1943; and mail-ton miles, from 21,066,627 in 1942 to 37,638,833 in 1943. Graphs help to visualize the comparison of 1943 figures with earlier years.

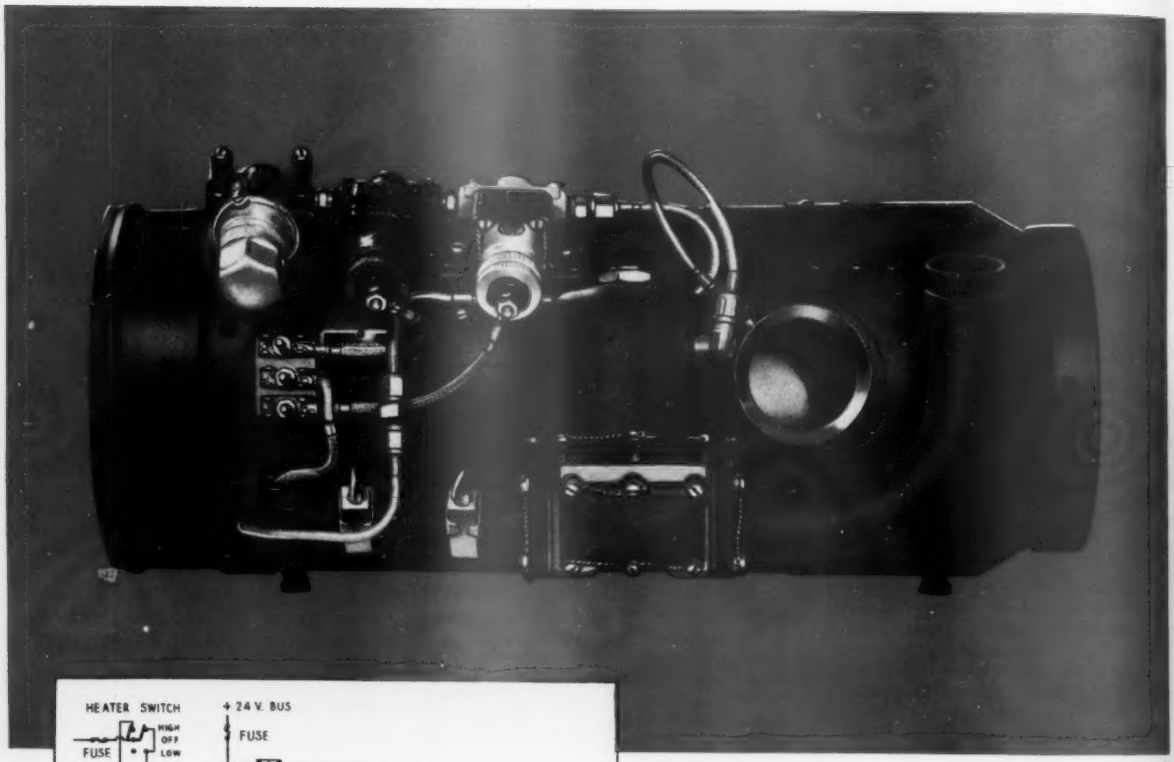
Dehydrated Wing Spars Pique Plane Owners, So CAA Counsels Cause and Care. Information is given on the maintenance of wooden wing spars in arid regions where trouble is experienced from cracking. Artificial humidifying means of protection are mentioned, but such methods are considered only temporary expedients. An outline is given of satisfactory methods of repair for various airplanes affected, which have been developed by CAA's aircraft engineering branch offices and the manufacturers concerned. *Civil Aeronautics Journal*, December 15, 1943.

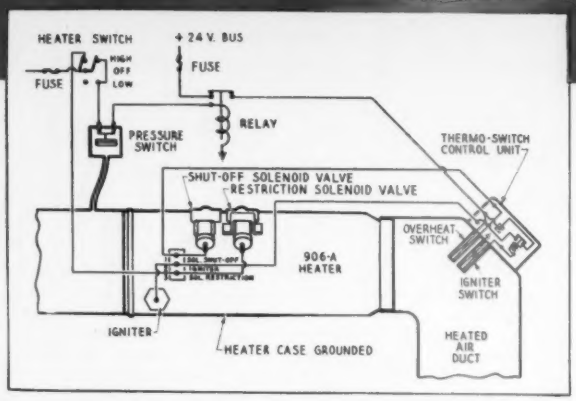
Flight Engineering Report No. 8, "Equipment for Recording Airplane Take-Off and Landing Characteristics—Using Two Fixed Position Cameras." This report was prepared for the purpose of describing photographic equipment developed by the Technical Development Division of the Civil Aeronautics Administration but used by the Flight Engineering and Factory Inspection Division to measure take-off and landing flight paths of airplanes. It was designed basically to serve as a manual for the information of the industry regarding proper use of the camera equipment.

Instructions are given for operating photographic portable equipment for recording the take-off and landing characteristics of seaplanes or flying boats. The equipment described, one of two types used by the Civil Aeronautics Administration, is particularly adapted to tests of aquatic airplanes. For land aircraft, another photographic method and set of equipment is used as described in Civil Aeronautics Administration, Flight Engineering Report No. 1.

The apparatus described and used as indicated has for its purpose the accurate kinetographic determination of take-off and landing characteristics of aquatic airplane testing because of the small space occupied by the setup on the shore of the chosen water course over which test runs are to be made and

The Heating Team That Under Most Severe





Wiring diagram showing a typical use of the South Wind Model 906 with South Wind Duct Pressure Switch and Thermo Switch Control.

• • •

NEW MANUAL providing detailed information regarding the performance, specifications, installations and operation of this heater has been prepared for you. Ask for the "Model 906 South Wind Heater Manual."

THE MODEL 906A SOUTH WIND HEATER is a ram-operated, injection type internal combustion heater with an output of 50,000 BTU/hr. It may be operated entirely independently of the aircraft engines, as it requires for operation only the supply of gasoline under pressure, electricity, and the flow of air. It offers you these specific advantages:

1. It will not "lead up" when burning high-octane aviation fuels.

2. It will ignite and operate over the full range of voltages encountered in aircraft service—from 23.5 to 28.5 volts.

3. It will ignite and operate reliably—
—at all altitudes to 25,000 feet—and more
—at temperatures down to —65° F.—and lower
—at indicated airspeeds from 100 to over 270 mph.

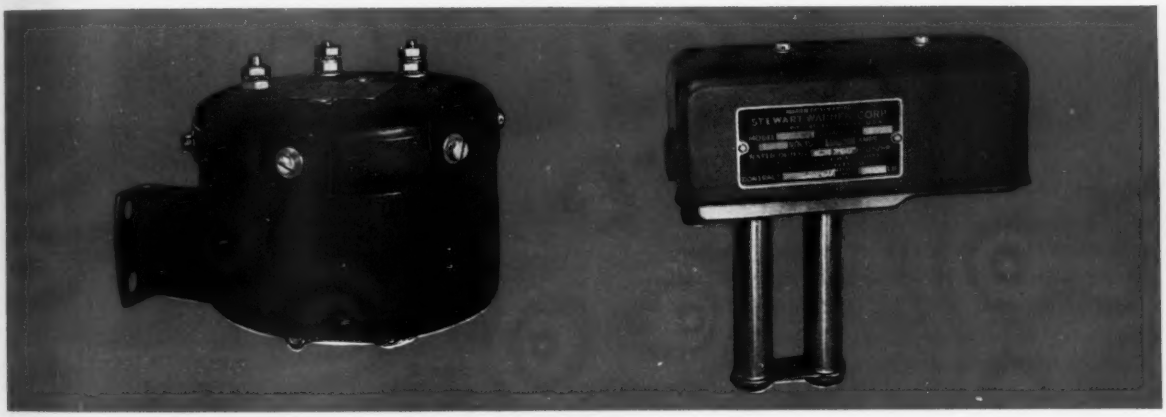
4. Its low ventilating air pressure drop (less than 2¼ inches of water with 180 c.f.m. of standard air, sea level, 50,000 BTU/hr.) permits a smaller, lighter duct system.

5. It requires a minimum of maintenance.

Has Proved a "Stand-Out" Service Conditions

See If Performance Data Like This Doesn't Suggest An Answer to Your Heating Needs

BECAUSE they're engineered as a *heating system*—teamed from the start to work together—the South Wind "accelerating-flow" heater and the accessory controls developed for it are delivering performance in the field that merits your attention. This versatile heating team—light, compact and more than ordinarily dependable—lends itself to varied requirements, both in installation and operation. All wiring and controls are externally mounted, providing easy access for checking or adjustment. Most important of all, the entire heating system embodies the benefits of South Wind's unmatched field experience. And the difference is showing itself in performance . . . out in the toughest service areas.



SOUTH WIND PRESSURE SWITCH . . . for duct-pressure control of ram-operated heaters, automatic landing flap control and similar uses.

A compact, light-weight control with special anti-vibration damping mechanism.

Operating pressure quickly adjustable from 2 to 12 inches of water.

Pressure differential between opening and closing . . . 1½ inches of water plus or minus ½.

Will operate at temperatures from 150° to –70° F.

Withstands vibration with total amplitude of 1/16" at frequencies below 3600 cycles per minute for 15 hours—will not "chatter" when subjected to vibration of 1/32" amplitude at 2400 cycles per minute.

SOUTH WIND THERMO SWITCH . . . combines automatic control of heater ignition and automatic overheat control.

Hermetically sealed control elements are unaffected by dust, frost, oil or moisture in duct air.

Quicker response restores normal heater operation 4 to 5 times as fast after overheat.

Temperature settings can be adjusted to suit particular installation requirements without disturbing heater—and are accurate within ± 3° F. Calibration and adjustment can be made with tools available in the field.

Has been successfully tested under vibration of 1/16" total amplitude at 3000 cycles per minute, for 15 hours.

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Stinson (Vultee) L-1A "Vigilant" equipped with Edo Model 77 Amphibious Float Gear . . . Companion-in-service to the giant Edo-equipped C-47.

Edo's well-known line of standard floats is now augmented by several amphibious models that may be operated from land, water or snow. Already Edo has equipped, with amphibious floats, airplanes ranging in gross weight from 1300 lbs. to 29,000 lbs. This exclusive Edo development is one of the outstanding and timely contributions of the American aircraft industry toward victory on our land-sea-air fronts. When peace comes, flying for pleasure and business will gain in freedom and usefulness through the use of Edo amphibious float gear.

A "flick of the switch" extends or retracts the electrically operated wheels of Edo Amphibious Floats. 1. Bow wheel fully extended—main doors closed. 2. Bow wheel fully retracted—all doors closed.

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because it requires no marking along the flight course.

Part I is a field manual with essential instructions needed for setting up the equipment, operating it, and analyzing the films for conversion of the photographic record to engineering data. Part II includes reference material with more detailed instruction for the use and care of the equipment. It covers the history of the development of the method, the geometry and precision involved, and the derivation of the film analysis charts. Pertinent illustrations are grouped at the end of the report. *Safety Regulation Release No. 152*, October, 1943.

Airplane Paint Removers and Cleaners. This information has been prepared at the request of the Air Carrier Division because of cases of unsatisfactory experience with paint removers and cleaners and the probable increase in the use of these materials, particularly since many aircraft in military service are now being returned for conversion to civil use. Unsatisfactory agents or their improper use may cause costly damage and, in some cases, affect the airworthiness of the aircraft and their components. The information is presented under the following heads: Government Specification Products; Proprietary Products; Hints and Recommendations Regarding Method of Application; Wax Content of Paint Removers; Tabulation of Paint Removers and Cleaners; Specification Comments. *Safety Regulation Release No. 155*, November, 1943.

ANC-17 "Plastics for Aircraft." For the information of the aircraft industry and other interested parties the ANC Technical Subcommittee on Plastics under the guidance of the Army-Navy-Civil Committee on Aircraft Design Criteria has prepared a new ANC publication, ANC-17, "Plastics for Aircraft."

It is expected that ANC-17 will be placed on general sale at the Government Printing Office, Washington, D.C. A notice will be inserted in the *Civil Aeronautical Journal* advising when ANC-17 is available at the Government Printing Office.

This publication presents general information to assist airplane designers in the application of plastic materials to aircraft design. The many inquiries received from airplane manufacturers requesting information on the use of plastics have indicated the need for a recommendation of this nature. *Safety Regulation Release No. 156*, November, 1943.

Strength of Aircraft Elements. Amendment No. 1 to the December, 1942, Edition of ANC-5 has been approved by the Technical Committee of the Army-Navy-Civil Committee on Aircraft Design Criteria. Although the general content of ANC-5 remains substantially the same, several important revisions have been made to the text and to the mechanical-properties tables of certain materials. An outline of the more important changes to ANC-5 as covered by Amendment No. 1 follows: (1) The first paragraph of Section 1.02 has been revised and material inserted, explaining changes made by both Army and Navy in regard to the basis of selection for design allowables for certain materials. (2) A note has been added to Section 1.543 giving Army and Navy instructions for reducing test results on aluminum alloys to standard values. (3) Table 1-1 dealing with grain properties of aluminum alloys has been revised. (4) The equations for round steel tubes under combined loadings in Sections 4.40 and 4.42 have been modified. (5) In Table 4-9 and 4-10 a note has been added pertaining to the design of castings. (6) Section 5.00 has been revised and pertinent material inserted explaining changes made in the Aluminum Alloy Mechanical Properties Tables. (7) The equations for round aluminum-alloy tubes under combined loadings in Sections 5.40 and 5.42 have been modified. (8) The text material in Section 5.500 dealing with allowable shear values for rivets, bolts, and pins has been revised. (9) The text material in Section 5.501 dealing with bearing allowables for aluminum alloys has been revised. (10) The Aluminum Alloy Mechanical Properties Tables 5-2 through 5-14 have been revised. (11) Table 5-15, Shear and Bearing Strengths of Aluminum Alloy Rivets and Sheet, has been marked obsolete. (12) A note has been added at the bottom of Tables 6-5, 6-6, and 6-9 pertaining to the use of design allowables in the design of castings. *Safety Regulation Release No. 157*, December, 1943.

Fundamentals of Elementary Flight Maneuvers. A 66-page booklet furnishes elementary information on flight maneuvers for trainees. Procedures that should be followed when starting the engine are outlined, and instruction is given on taxiing. The effect of the controls is explained. Sections discuss various types of turns, climbs, stalls, approaches, landings, and other maneuvers. *Civil Aeronautics Bulletin No. 32*. For sale by the Superintendent of Documents, Washington, $0.20.

Civil Aeronautics Board

Annual Report of the Civil Aeronautics Board. The 1942 report of the activities of the Civil Aeronautics Board, which was submitted to Congress, has been published. Some of the principal developments reviewed are: the substantial and vital services contributed by air carriers to the military establishments; redirection of the Board's activities toward functions immediately identified with the war program; wartime control of schedules made necessary by the transfer of half of the air-line equipment to the Government; establishment of an air priority system of air-line travel; safety measures adopted to aid in the use of airspace by the military and civil organizations; the continued increase in commercial air transportation and the improved financial position of the air lines; wartime procedure for authorizations of new service; the adoption of new procedure in fixing rates of mail compensation to improve and accelerate disposition of these matters.

Other activities reported are: the disposition of problems arising through the accumulation of profits by air lines during the pendency of rate proceedings; the adoption of new bases in computing mail compensation to permit the use of all schedules by the Post Office Department for the carriage of mail, with consequent operational advantages to both the Department and the air lines but without additional cost to the Department; proceedings relating to the acquisition of control of air carriers by other common carriers.

Still other developments noted are: the broadening of research activities to enable the Board to fulfill its duty to encourage and develop civil aeronautics and to enable it to handle effectively the many problems that will arise from the demands upon civil aviation in the postwar period; the expansion of air transportation by American flag carriers in international service; the aid that is being given to carry out the Government's "good neighbor" policy in the other American republics; modification of Civil Air Regulations to guard against sabotage and to provide other measures deemed essential to the national defense; the functions of the Civil Air Patrol in its work in assisting the military in the national defense. For sale by the Superintendent of Documents, Washington, $0.30.

Civil Air Regulations Part 04—Airplane Airworthiness. This regulation has been amended to November 1, 1943. It contains 48 pages of text and tables under the following general heads: General; Definitions; Structural Loading Conditions; Proof of Structure; Detail Design and Construction; Equipment; Power-plant Installation; Performance; Miscellaneous Requirements. Tables, graphs, and drawings occupy the final 6 pages. For sale by the Superintendent of Documents, Washington, $0.15.

Uniform System of Accounts for Domestic Air Carriers contains detailed instructions for keeping the accounts of domestic air transportation companies in accordance with the uniform accounting practices prescribed under the regulations. General instructions are set forth under the following headings: Records; Accounting Period; Allocation of Revenues and Expenses; Delayed Items; Foreign Exchange; Contingent Assets and Liabilities; Interpretation of Item Lists; Submission of Questions. Specific items are set forth as follows: balance sheet accounts; operating revenues accounts; operating expense accounts; income accounts; reporting procedure. *C.A.B. Form 2790 Manual 1-1-42*. For sale by the Superintendent of Documents, Washington, $0.65.

Appointment at Seven...
SEVEN MILES...UP!

Seven miles or more above Nazi earth a big, barrel-chested, brutal-looking fighter plane has an appointment with a Focke-Wulf. This appointment was written down in the engagement book of the Army Air Forces a long time ago, *before we had a fighter plane that could work effectively at 35,000-40,000 feet.*

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In designing a six-ton stratosphere fighter, Republic Aviation solved many long-standing problems in the field of high speed, high altitude aircraft. After the war, long distance commercial planes will fly more safely, more swiftly, more economically—because they'll fly *high*. Republic Aviation Corporation, Farmingdale, L. I., N. Y. and Evansville, Ind.

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SPECIALISTS IN HIGH-SPEED AIRCRAFT • *MAKERS OF THE* **Thunderbolt**

The Aeronautical Board

Army-Navy Aeronautical Specifications have been approved by joint action of the War and Navy departments for use in the procurement of aeronautical supplies and become effective upon publication of the applicable *ANA Bulletin*. They follow a general form comprising the following headings: applicable specifications; type; material and workmanship; general requirements; detail requirements; methods of sampling, inspection, and tests; packaging, packing, and marking for shipment; requirements applicable to individual departments; and notes.

A current list of such specifications follows: AN-P-37, hand-operated engine primer pumps; AN-N-6, aircraft fuel and oil servicing nozzles; AN-D-8, cellulose nitrate pigmented camouflage dope; AN-C-113, cellulose nitrate predoped airplane cloths; AN-C-90a, true air-speed computers; AN-P-51, petrolatum; AN-C-115, cotton-back rayon twill cloth; AN-C-67a, moisture-impervious containers; AN-C-112, high tear-resisting sateen cotton cloth; AN-V-20, air pump safety valves; AN-P-5a Amendment-1, electrical position indicating assemblies for wheels and flaps; AN-D-10, engine exhaust flame dampers; AN-V-21, air pump suction relief valves; AN-F-31, air pump suction relief valve filters; AN-P-50, engine-driven air pumps; AN-M-16, magnesium-alloy die castings; and AN-C-114, new blemished aircraft tire casings.

The following amendments and notices are also current: AN-C-83 Amendment-2, protective coatings (for wood); AN-G-6 Amendment-1, lubricating graphite grease; AN-VV-P-236, Notice No. 1, petrolatum. Other amendments cover nylon parachute cloth; aircraft-engine fuel, grade 91, and aircraft spruce.

ANA Bulletins have recently become effective as follows: No. 137d, low-temperature lubricating grease, Specification AN-G-3a; No. 148, aircraft gloss enamel, Specification AN-E-3; No. 102a, cellulose-nitrate lacquer; No. 166, list of standard aircraft glossy colors; No. 162, moisture-impervious containers.

Army-Navy Aeronautical Standards sheets have been issued on the following general classes of equipment: nuts, rivets, elbows, hose assemblies, flanges, hose grommets, field floodlighting trucks, receptacles, nozzles, light assemblies, lamps, starter-shaft dust covers, sleeves, springs, pressure gauges, air-pump valves, and filters.

Army-Navy Aeronautical Design Standards sheets recently issued cover design requirement for engine-data plates and smooth-contour master auxiliary wheel rim contours.

The regular monthly index of **Army-Navy Aeronautical Standards** includes **Army-Navy Aeronautical Specifications,** drawings, and bulletins. A numerical list covering Army Air Forces and Army-Navy Aeronautical Standard Parts is also revised monthly and is supplied to manufacturers who do not require the complete Standard Book so that their files can be kept up to date.

Bureau of Labor Statistics, Department of Labor

Earnings in Eastern and Midwestern Airframe Plants, 1942. Compiled from articles appearing in the Monthly Labor Review, this report is based on the wage data obtained in the course of nation-wide study. *Bulletin No. 728.* For sale by the Superintendent of Documents, Washington, $0.10.

Post Office Department

Cost Ascertainment Report for 1942 shows the cost of carrying and handling the several classes of mail matter and of performing the special services for the fiscal year 1942. It is the 17th annual report, compiled in accordance with established procedure and submitted according to law. In addition to the text matter, tables give detailed figures on revenues and expenditures for the different classes of mail, including air mail.

An appendix to the report contains graphic charts and tabulated figures giving a detailed breakdown of the revenues and expenses of the department. Report for sale by the Superintendent of Documents, Washington, $0.10; appendix price, $0.45.

Public Roads Administration

Principles of Highway Construction as Applied to Airports, Flight Strips, and Other Landing Areas for Aircraft are set forth in a 514-page report. Information is given on the selection of the site, grading, drainage, flexible bases and surfaces, rigid pavements, and the use of turf on airports. An appendix contains Public Roads Administration specifications and tables of information on highway construction. For sale by the Superintendent of Documents, Washington, $1.00.

War Department

Biennial Report of the Chief of Staff of the United States Army . . July 1, 1941, to June 30, 1943 . . . . . A report has been issued summarizing important events affecting the U.S. Army during the period covered. One section refers to the problems and accomplishments of the Army Air Forces during the war emergency. Among the charts furnished is one showing the organization of the Army Air Forces. For sale by the Superintendent of Documents, Washington, $0.75.

Physiological Aspects of Flying. A manual explaining in nontechnical terms the various physical and physiologic problems that arise during flying, and furnishing detailed information on proved solutions to these problems. The effects of high-altitude flying and pressure changes on the human body are described. Other sections discuss anoxia, parachute descents, oxygen equipment, carbon-monoxide poisoning, how changes of motion affect the body, airsickness, night vision, the effects of extreme temperature, and types of first aid kits. *Technical Manual T.M. 1-705,* September, 1943. For sale by the Superintendent of Documents, Washington, $0.15.

Applied Physics for Airplane Mechanics. This manual for aircraft mechanics has been issued to furnish elementary information on applied mechanics, heat, fluids, aerodynamics, electricity, and magnetism. *Technical Manual T.M. 1-760,* September, 1943. For sale by the Superintendent of Documents, Washington, $0.15.

Construction of Weather Maps, Charts and Diagrams. This supplement outlines in detail the methods for plotting of observation data, for entry of analysis, and for preparation of supplementary maps, charts, and diagrams for all Army Air Forces weather stations. The primary purpose for the outline of these methods is to secure uniformity in the weather maps, charts, and diagrams prepared at Army Air Forces weather stations. *Supplement Technical Manual T.M. 1-235,* February 2, 1943. For sale by the Superintendent of Documents, Washington, $0.10.

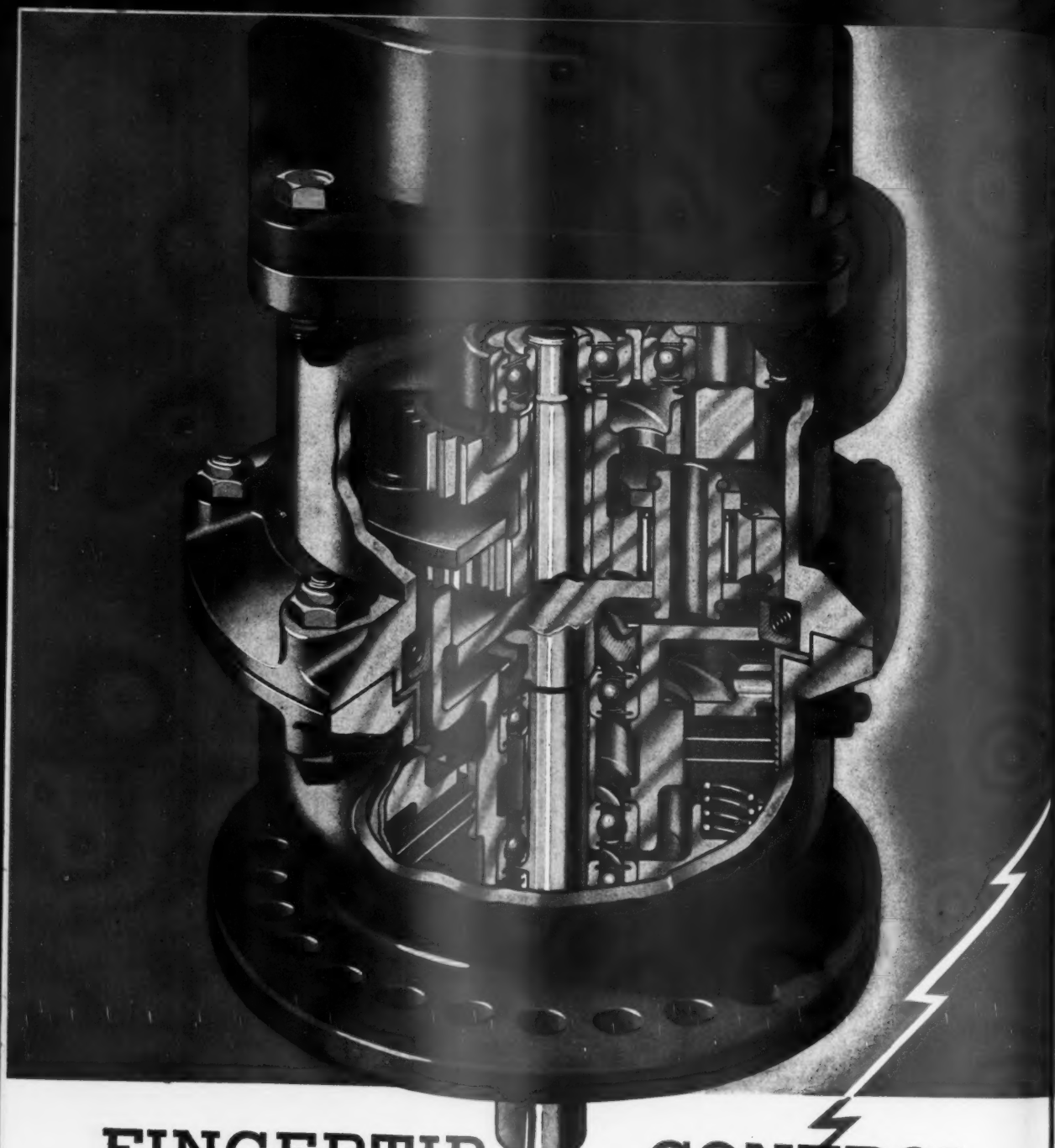
War Production Board

A report addressed to T. P. Wright, as Director of the Aircraft Resources Control Office, from the Director of the Steel Division outlines the organization, responsibilities, and objectives of the group in the solution of the problems of steel forgings for aircraft. It also reviews the activities of the Aircraft Scheduling Unit as applied to steel forgings. *Aircraft Resources Control Office.*

British Information Services

A Graphical Method of Calculating the Performance of an Airscrew. C. N. H. Lock. (Revised edition of R. & M. No. 1675.) A rapid method of making calculations of airscrew performance by means of charts is described. The first application is to ordinary strip theory calculations on the basis of the formulas of R. &. M. No. 1674.

Three charts are required for each of the radii for which the value of thrust grading, etc., are to be derived; these depend on the number of blades but are otherwise universal, being independent of shape of blade section, while they do not involve the blade



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Operating bomber controls is no job for muscle and main strength. American aircraft must continue to become more and more fully automatically operated. This seventeen pound package of motor, clutch and gears is a wing flap operating unit for modern heavy bomber or cargo planes. Powered by a General Electric motor, it is a torque shaft type actuator with multiple gear reduction developing 600 in. lbs. of torque. It has been fully tested for high altitude operation.

Pacific actuators are used for extending and retracting landing gears and doors, nose wheel gears and doors, bomb bay doors, bomb hoists and similar applications.

WRITE FOR YOURS

We have just published a new handbook on Pacific Aircraft Actuators, giving dimensions and specifications for fifteen different type units. Aircraft engineers and officials may obtain a copy of this handbook by writing on company letterhead.

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PLANTS: SEATTLE, LYNWOOD, VERNON, SAN FRANCISCO

width or blade angle explicity. To these must be added a single universal table or curve for each radius, together with curves of the lift and drag coefficient of the blade sections.

The second application gives a considerable further simplification in that the charts are required for a single standard radius (0.7) only. The accuracy of the second method is increased if the lift and drag values are deduced by analysis of observations on actual airscrews, an analysis which can be performed rapidly by means of the charts. Such an analysis of the results of the wind-tunnel tests of high pitch airscrews shows that the method will give reasonably consistent results over a range of pitch ratio from 0.3 to 2.5 and over the range of blade widths and number of blades likely to occur in practice. Changes of blade section and also of plan form and twist may be allowed for if necessary by modifying the lift and drag curves.

The accuracy of application of the second method to full-scale airscrews may be improved by basing the lift curves on full-scale values of power, speed, and revolutions. A table of lift and drag values for four shapes of section and a range of tip speeds has been based on two N.A.C.A. reports.

Tables are included (Table 1) giving data for the construction of charts for two- and three-bladed airscrews at the following seven values of the radius: $x = 0.3, 0.45, 0.6, 0.7, 0.8, 0.9$, and 0.95. Actual charts are given for two-, three-, and four-bladed airscrews, for the standard radius 0.7 only, for use in the simplified method. The tables for the simplified method (Table 2) also include six blades and infinity blades.

A brief account is given of a method recently published by Driggs of calculating the performance of a constant-speed (variable-pitch) airscrew when the power input is given and the blade angle unknown. The additional charts necessary for this purpose are included. *Ministry of Aircraft Production, Aeronautical Research Committee, R. & M. No. 1849*, British Information Services, New York, $3.25.

Vocabulary of German Military Terms and Abbreviations. A vocabulary of German military terms published in revised form. A number of new words and meanings, many of recent origin, have been added. *The War Office, General Staff*, $1.05.

(*Continued from page 11*)

cies in the exchange of reports from the synoptic network several times daily on land, at sea, and in the air, not only over the United States and its territories but from foreign regions as well. Daily weather maps for the hemisphere or the globe are indispensable to international air commerce.

International Pattern

Weather is an international matter. Air masses that produce it do not stop at international boundaries. In general, however, weather is regarded as the property of the nation where it occurs and weather observations must usually be obtained by exchange of information with the country concerned. The prevailing national policies prevent organization of a single global network, suggested in a preceding paragraph as the meteorologic ideal, and practical economy, as well as national policy, prevents the establishment of duplicate synoptic station networks throughout the world by the major powers. The international exchange of weather reports for common use of all nations in times of peace is therefore a logical arrangement. To serve their purpose in the comparative methods and techniques of synoptic meteorology, it is necessary to standardize international observations, units of measurement, forms of reporting, and related practices. Communications channels must be extensive in coverage and prompt in transmission. Collection centers to process and disseminate the reports must be suitably situated and adequately staffed. In some countries meteorology is further advanced than in others. An international plan perhaps similar to that for the North Atlantic Ice Patrol is needed to give weather observations and reports at sea and on land where the country concerned is unable to furnish them. Other questions arise from the differences in national policies pertaining to government ownership and operation of air carriers. In some respects meteorologic responsibility cannot be separated from responsibility for operations, dispatching, and traffic control; in others, it rests with government for reasons of national interest and public welfare. Questions of weather operating minimums are involved as well as other safety considerations. International agreements are needed to protect the company with high operating standards in meteorology from unfair practices of competitors who may be inclined to disregard official weather information. Equitable practices that take into account operating and meteorologic responsibilities should be established whether these rest solely with government or partly with private companies. In every country a national meteorologic authority is necessary to operate the basic reporting network and provide standard weather service, including forecasts and warnings for general guidance.

Procedures

Meteorologic services will be expected to solve different problems on different routes, and there must be agreement as to the procedures wherever international boundaries are crossed. Routes across polar regions will call for special information of temperature and icing conditions. Routes through the temperate zones will experience the frequent changes in wind, visibility, cloud ceiling, and other flying conditions, typical of the United States with its succession of extratropical cyclones. The relatively fair weather routes of tropical regions will place emphasis primarily on wind reports at flying levels, although during some seasons reports of hurricanes will be important. In equatorial regions reports of the frequently heavy rain squalls of the intertropical zone will be of interest to operators when these storms develop into proportions that make it difficult for the pilot to find his way around except by study of an adequate weather map.

These general features of meteorology related to air commerce between nations have been reviewed to bring out the special international aspects of the subject. Meteorologic service is inherently a matter of world-wide coordination. Its problems need not be examined in detail here; there are international organizations that have been assigned this task. Before the war the International Meteorological Organization worked toward adoption of uniform standards in synoptic meteorology and coordination in the exchange of weather information among nations. These objectives have been advanced in some respects by special governmental agencies since the war began. It is certain that world weather is such that adequate meteorologic service cannot be had by independent national action but only through international coordination. The steps that should be taken in plans and agreements on air commerce between nations may be stated in general thus:

(1) Extend and integrate (including standardization) the basic network of synoptic weather stations throughout the world. Establish stations in regions that now have large "blind" areas on land or at sea.

(2) Organize an in-flight reporting system to amplify synoptic reports where the network is inadequate.

(3) Standardize terminal spot weather reporting methods and related procedures.

(4) Provide adequate communication channels for international exchange of weather reports.

(5) Agree that basic synoptic reports of all kinds shall be available for common use of recognized interests of all nations.

(6) Encourage technical improvements and research in meteorology and give wide dissemination to improved techniques in the interest of general advancement of weather forecasting and other forms of meteorologic services.

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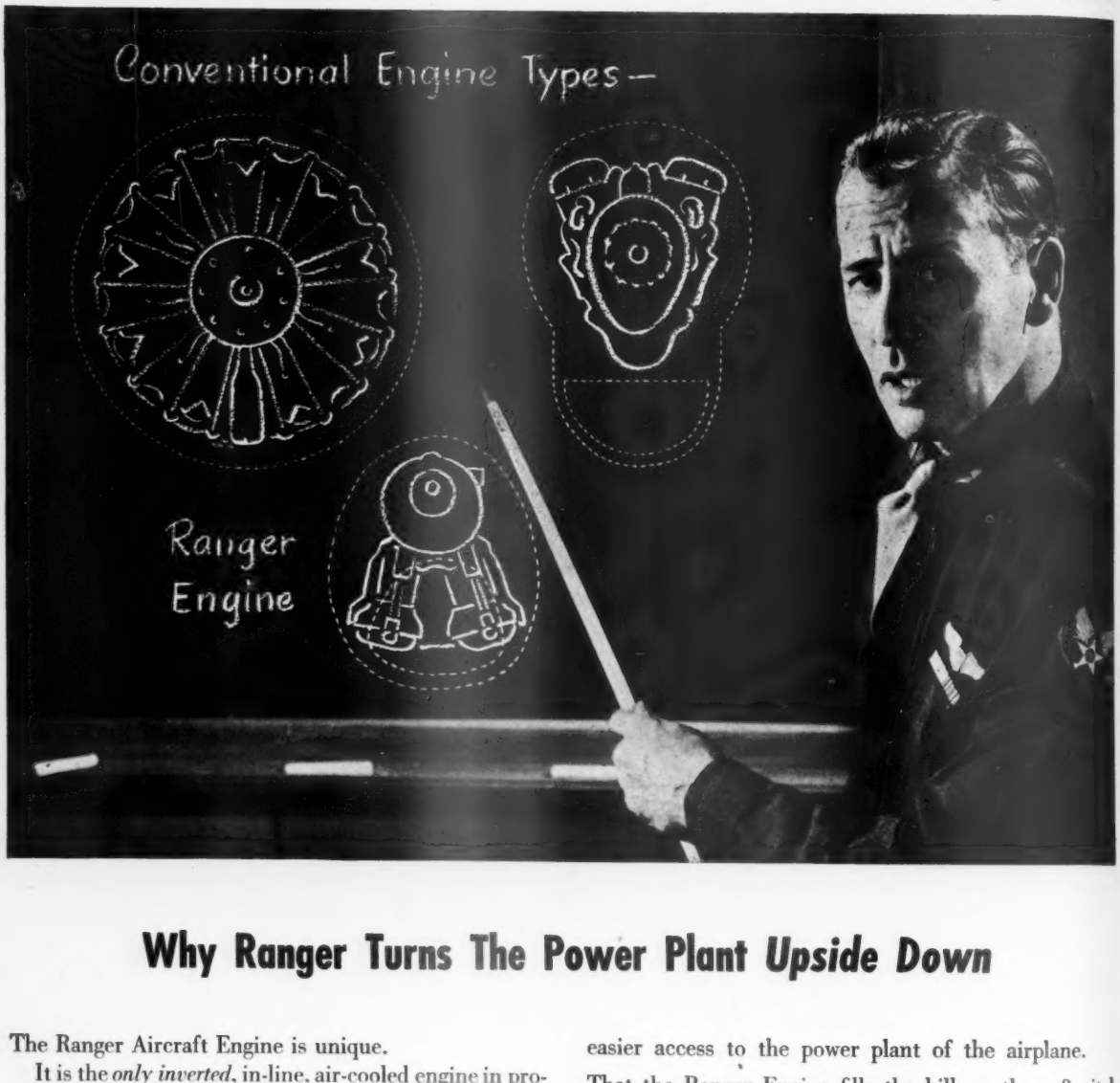

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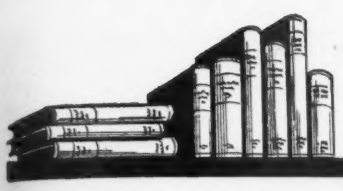

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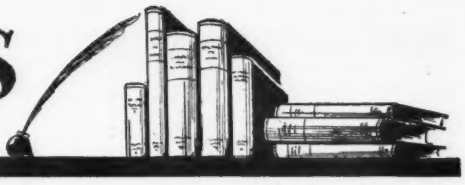


Books reviewed in this section may be borrowed without charge from The Paul Kollsman Library, Institute of the Aeronautical Sciences, 1505 RCA Building West, 30 Rockefeller Plaza, New York 20, N.Y.

Tomorrow We Fly

William B. Stout and Franklin M. Reck

Contents: Bringing Us Up to Date; Traveling Tomorrow's Airline; Taking Care of Tomorrow's Traffic Jam; Flight Safety After the War; Private Flight Up to Now; Traveling by Helicopter; Airplanes on the Highway; What Air Express Will Cost; The Battle for Air Cargo; Aviation to Colonize the World; How the Airplane Will Affect Other Products; International Airlines Up to Now; Polar Routes for Tomorrow; What International Travel Will Be Like; Contest for Air Routes; After Tomorrow, What?

No one better than Bill Stout could write a book giving a prophetic view of what the airplane of the future may be like. For many years he has been making predictions and helping them to come true. In this book he and his associate author see air travel growing to almost unbelievable size, with comforts and speeds increasing to meet the demands of the public. He foresees the helicopter selling at $700, and space for 100,000 of them to land on roofs of New York City alone. The roadable airplane, of which he has always been a proponent, will come after the war, and other types of private airplanes will provide a great market for the aircraft industry. Express, cargo, and mail will increase to great loads for the air lines.

The influence of this expansion of the use of the airplane on the world of tomorrow and the changes it will make in bringing countries closer together, of shrinking the lines of transportation, and of opening of new Great Circle routes are all considered, with the background of long experience. It is a book that embraces the ideas of the visionary tempered by the caution of one who hopes to have a part in making the dream a practical reality. Thomas Y. Crowell Company, New York, 1943; 160 pages, $2.00.

Brassey's Naval Annual 1943

Edited by Rear Adm. H. G. Thursfield

Contents: A Naval Chronicle of 1942; Foreign Navies; The War on Shipping and Supplies; Air Operations and the War at Sea; The Modern Conception of Sea Power; The U-boat War; Submarines and Light Coastal Craft in 1942; U. S. Navy, Official Documents; Sea Power and the Air Weapon; Dimensions and Particulars of Ships of the Larger Navies; Ships of the Lesser Navies; Flotillas of the World; Ship-Borne Aircraft; Diary of Naval Events, 1942; First Lord's Statement of Navy Estimates, 1943; Principal Naval Officials, British and Foreign; British and Foreign Naval Attachés.

This standard reference book on the navies of the world indicates by its attention to "air power" that the naval mind, confronted with the results that have been achieved by torpedo and bombing aircraft, is now, more than previously, glad to admit that the airplane is having an important effect on naval, as well as military, tactics and strategy.

Oliver Stewart, the well-known English writer on aeronautics, contributes a chapter on "Air Operations and the War at Sea." Writing for a book that is essentially a naval handbook, he would not be expected to take the airman's point of view against naval opinion. He prefers to see in the early operations of the war a transition of ideas which marked the final abandonment of extreme all-air theories and the adoption of the theory of the "balanced force." He describes the gradual improvement of British naval aircraft.

Another chapter by an anonymous writer on "Sea Power and the Air Weapon" is largely devoted to combating Major de Seversky's ideas of air power. It is an exposition of the conservative naval attitude toward the airplane.

The reference section is replete with detailed descriptions of all types of warships of all countries, including aircraft carriers. The dimensions, speed, range, and armament of British, American, German, and Japanese ship-borne aircraft are given in tabular form. The Macmillan Company, New York, 1943; $5.00.

American Heroes of the War in the Air

Howard Mingos

Contents: Pearl Harbor; The Philippines and Java; Our Navy Takes First Offensive; The First Raid on Japan; The Battle of the Coral Sea; The Battle of Midway; The Campaign in the North Pacific; The Fight for Island Air Bases; American Wings Over Asia; North Africa and the Mediterranean; The Air Campaign Against Germany; Our World-Wide Lines of Supply.

An ambitious and worthy purpose has been served by the longtime author of the *Aircraft Year Book* in assembling what might be properly called "Who's Who in American Heroism." After brief sketches of the action that occurred in battle and transport areas, a list is given of the officers and enlisted men who received medals for service and valor. Many citations are given in full, but in most cases only the name, home city, and award are given. Over 6,000 Americans are cited who have made records worthy of commendation.

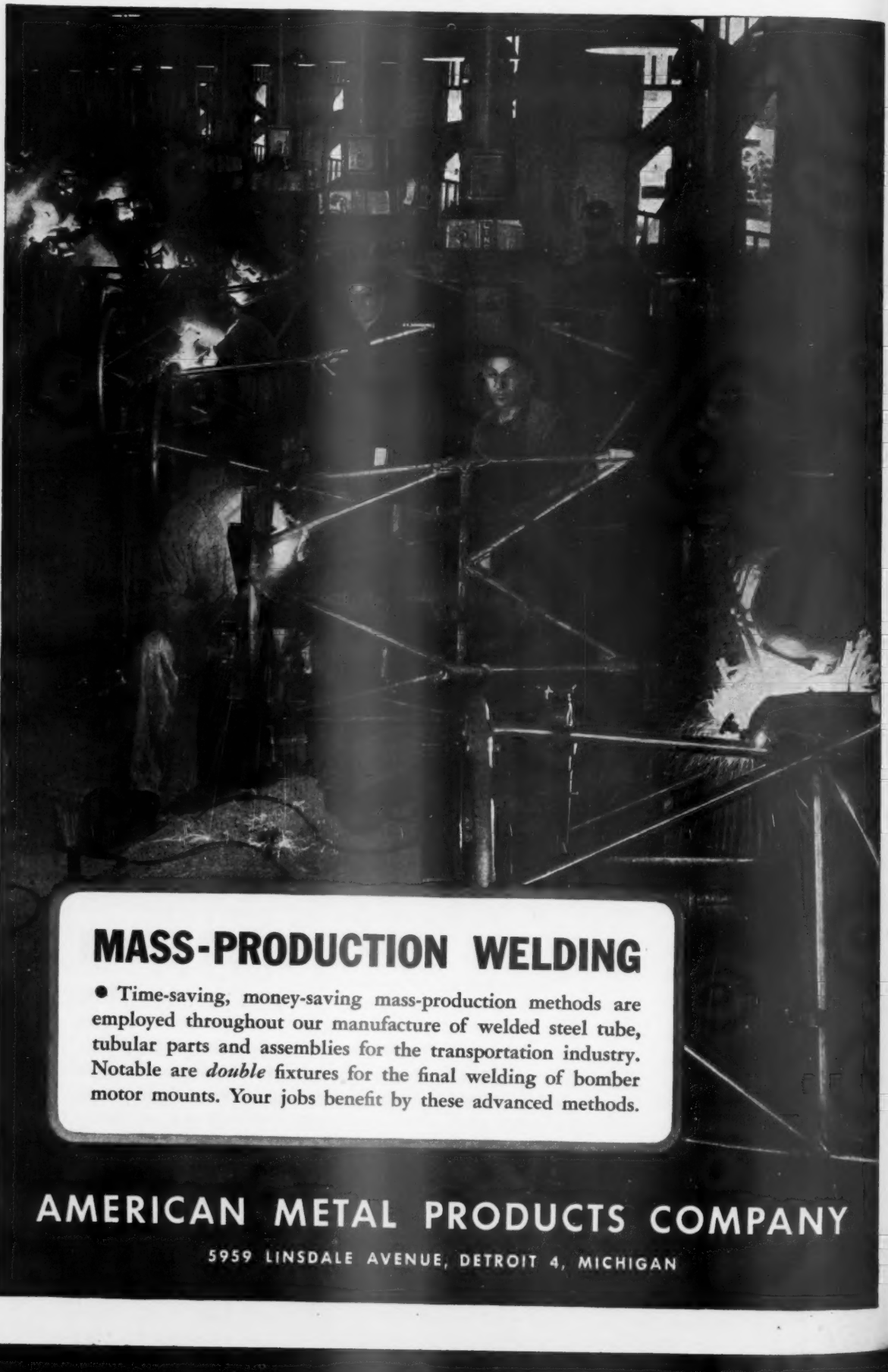
Although every effort was made to secure the names of all those who had been decorated up to the middle of 1943, a second and probably more volumes will be needed to keep the records complete, this expansion depending on the duration of the war.

These well-illustrated volumes may well be considered the most authentic account of the heroic achievements of our Army, Navy, and Marine airmen in this war. Lanciar Publishers, Inc., New York, 1943; 557 pages, $10.

The Flight Testing of Production Aircraft

J. A. Crosby Warren

Contents: The Purpose and Principles of Testing—The Effect of War on Test Procedures—The Test Pilot's Relationship with the Factory Management, with A.I.D. and Works Inspection Department; Airframe Tests and Fault Analysis—Ground and Cockpit Tests—Testing Flying Controls—Checking Performance; Engine and Airscrew Tests and Fault Analysis—Ignition and Carburation Tests—Checking Engine Performance and Cooling—Airscrew Tests, Including Feathering; Tests and Fault Analysis for Ancillary Equipment—Retractable Undercarriages—Automatic Pilot—Armament and Wireless—Hydraulic, Electric and Pneumatic Services; Instrument Testing—Tests Prior to Installation—Air Test for Flying Instruments and Engine Instruments—Analysis of Instrument Faults; Check Tests for Aircraft After Storage or After Shipment; For Operating Pilots of the R.A.F. and of Air Operating Companies—For Private Owners and Managers of Flying Clubs and Schools—Tests Suitable for Operating Pilots Who Wish to Keep Their Aircraft in the Best Pos-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sible Trim; Short and Approximate Method of Reducing Production Performance Checks to Corrected Performance (for Comparative Purposes), in Standard Atmosphere; Factors Affecting the Standard of Testing—General Syllabus of Production Tests—The Relative Importance of Individual Tests on Different Classes of Aircraft; The Recording, Analysis and Control of Recurring Faults.

A manual on the principles and methods of testing production aircraft has been written for test pilots and those having to do with the manufacture of airplanes. The general faults likely to occur in the air frame and engine are described. From the experience gained in analyzing these general faults, the reader is expected to be able to deal with details that are not described. By consolidating in one volume the important aspects of production testing, the author has produced a book intended to be of value to pilots, engineers, and others engaged in the routine preparation for delivery of individual aircraft. Sir Isaac Pitman & Sons, Ltd., London, 1943; 131 pages, $3.00.

Air Acrobatics Are Easy

D. J. Brimm

Contents: Equipment; Stresses During Acrobatics; Sequence of Maneuvers; General Precautions; The Precision Spin; The Spin Over the Top; The Spin Underneath; The Power Stall; The Falling Leaf; The Pylon Eight; The Chandelle; The Wingover; The Lazy Eight; The Hammerhead Stall; The Whip Stall; The Loop; The Loop with Quarter Roll; The Cuban Eight; The Slow Roll; Inverted Coordination Exercises; The Inverted Spin; The Half Slow Roll; The Half Roll and Reverse Roll Out; The Immelmann; The Snap Roll; The Split S; The Vertical Reverse.

This pocket manual on aerobatics was prepared as an aid to flight instructors. It contains techniques in the performance of aerobatics ordinarily omitted from books on the general subjects of flying and has been written with the object of enabling the student pilot to learn aerobatics quickly.

Furnished with the manual is an instructional cardboard device with pictures, called the "aerobatic trainer," with which the visual effects of an airplane performing aerobatic maneuvers can be reproduced. McGraw-Hill Book Company, Inc., New York, 1943; 133 pages, $2.50.

Flying the Weather

Contents: A Pilot's Weather Observations; Air Mass Weather; Cold Front Weather; Warm Front Weather; The Movement of Weather; First Principles of Fight Planning; Flight Planning Based on Wind Aloft; Flight Planning for Fog and Low Ceiling Weather; Flight Planning for Thunderstorm Weather; Flight Planning with Icing Conditions.

A text and workbook written for aviation cadets who have completed an introductory course in aerology and have entered the second phase of their training. An elementary understanding of the nature and behavior of the atmosphere in its relationship to flying is required. The characteristics of air mass and fronts are briefly reviewed, as are the conditions under which weather hazards to flight are encountered. Emphasis is placed on acquainting cadets with specific, actual weather situations and flight-planning problems.

Flying conditions in air mass and frontal weather are portrayed by use of weather maps, weather reports, and pictorial cross sections correlated with maps and based upon surface and radiosonde observations and pilots' reports. Familiarity with sources of weather information for pilots is increased by report decoding, map completion, and forecast-reading exercises. Directions are included for observation and interpretation of the current weather in its relation to flying. Flight-planning problems are set to actual weather situations. Issued by Training Division of the Bureau of Aeronautics, U.S. Navy, 1943; 73 pages $0.55.

Fundamentals for the Aircraft Mechanic

James M. Markley

Contents: Sketching and Blueprint Reading; Shop Mathematics; Theory of Flight and Design; Airplane Construction and Materials; Hydraulics; Electricity; Propeller Operation and Maintenance; Engine Principles.

Intended as a basic course for those who have never performed mechanical work, this book gives information on the fundamentals of airplane construction, maintenance, and operation. The first chapters contain a sufficient amount of sketching, blueprint reading, and shop mathematics for the student to understand the material in the chapters following. McGraw-Hill Book Company, Inc., New York, 1943; 345 pages, $4.00.

Little Known Facts About the Air Transport Industry

In this fifth annual edition the air transport industry of the United States makes a report concerning its common-carrier operations from 1926, when it was established, through 1942. The information about 1942 operations covers only the domestic common-carrier activities of the air lines, omitting details on the military services performed at home and abroad, the training program for personnel, the maintenance and modification work for Army and Navy planes, and scores of other jobs done for the armed forces. It is not intended to record the important official passengers carried, the officers and enlisted men brought home for furloughs or hospital treatment and returned to duty, or the millions of V-mail letters, medical supplies, and military material flown to world-wide battle fronts.

Statistics are presented in the form of charts and figures showing passenger traffic and revenue, air-mail operations, express volume and mileage, airway distances, fuel consumption, and numerous other details, on a year-to-year comparative basis. The Air Transport Association of America, Washington, D.C., 1943; 25 pages, $0.15.

Navigation

Lyman M. Kells, Willis F. Kern, and James R. Bland

Contents: Fundamental Mathematics for Pilots; Instruments; Charts; Piloting; Navigation Aids, Rules of the Road, Tides and Currents; Ship and Plane Maneuvers; Review of Spherical Trigonometry; Sailings and Nautical Astronomy; Time; Air Almanac; Meridian Altitude; Fix; Nautical Astronomy and Star Identification; Logarithms; Range Finder; The Hagner Planetarium.

This book is offered as a complete course in which the mathematical background for each theory of navigation is set forth and treated by means of clear exposition. An examination of the text will reveal that simplicity has been obtained by a logical arrangement of material and careful preparation for each development. The aim of the author has been to present the latest methods used in navigation practice. Independent treatment of each navigational theory, illustrative examples, and numerous figures and diagrams are features. Detailed treatment is given of the four important methods of solving the spherical triangle. The basic review material on mathematics has been selected so that the student will gain needed mathematical knowledge while becoming familiar with essential concepts and procedures of navigation. A graded set of exercises follows each important topic. McGraw-Hill Book Company, Inc., New York, 1943; 470 pages, $5.00.

Aircraft Electrical Engineering

F. G. Spreadbury

Contents: Aero-Engine Ignition; The Design, Construction, and Testing of Ignition Apparatus; Aircraft Generators and Motors—Direct Current; Alternating Current in Aircraft; Voltage Regulation in Aircraft; Radio Supply in Aircraft; Ripple-Smoothing Circuits and Ripple-Voltage Measurements; Permanent Magnets and their Application in Aircraft; Aircraft Pyrometry.

The application of electrical engineering to aircraft is dealt with in a book written for the purpose of providing the

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engineer with an adequate basis for design purposes. The standard of electrical knowledge required for persual of the test is of an intermediate character, and the reader will require a knowledge of calculus. The author was a former lecturer in physics and mathematics at the Working Men's College, London, and the text is based on some 10 years of experience in the application of electrical engineering to aircraft problems. An examination of the chapter heads will reveal the broad scope of the treatment. Sir Isaac Pitman & Sons, Ltd., London, 1943; 272 pages, $6.00.

Airplane Performance and Operation

R. Dixon Speas

Contents: Standard Atmosphere; Engine-Control Procedures; Power Ratings and Engine Operation Procedures; Power Control; Operating Wrights and Speeds; Take-off and Landing Distances; Rates of Climb; Long-range Flight Technique; Flight Planning; Altimeter Settings; Navigational Computers; Airplane Loading; Conversion Charts.

This manual, written for the purpose of instructing flight crews in the various technical factors affecting airplane performance and operation, deals basically with the science of getting the most out of an airplane—of determining the conditions of engine operation that will produce a given desired result and of determining what can be done, both with the engine and with the air frame, without infringing upon the desired margins of safety. McGraw-Hill Book Company, Inc., New York, 1943; 121 pages, $1.50.

Book Notes

Four Miles South of Kitty Hawk; Warren McArthur Corporation, New York, 1943; 85 pages.

This brochure is the second edition and brings the history of flying up to October, 1943. The Almanac of the Air outlines the progress of aeronautics up to the success of the Wright Brothers.

The story of their work is given largely by quotations from their statements. The achievements of Glenn H. Curtiss, Glenn L. Martin, and other pioneers are recorded in short, pithy paragraphs.

To bring the history up to date, the events of the Battle of Britain and reports of the war in the air on all fronts are sketched.

With General Chennault: The Story of the Flying Tigers, by Robert B. Hotz, with assistance of George L. Paxton, Robert H. Neale, and Parker S. Dupouy; Coward-McCann, Inc., New York, 1943; 276 pages, $3.00.

The authors of this history of the Flying Tigers decided that there should be an authoritative history of the American pilots who served in China, and they pooled their information with the hope that any royalties from the sale of the book would be given to the American Volunteer Group Memorial Fund.

It carries the story of the Flying Tigers up to the time that they were merged into the Army Air Forces. It is a record of air fighting that has no parallel in history and will always be remembered as an outstanding achievement of airmen. It is fortunate that the complete record of the AVG is now available. It will show what a resourceful pilot leader can accomplish with limited equipment, under the most difficult conditions, if left to make his own decisions.

The Grim Reapers, by Stanley Johnston; E. P. Dutton & Company, Inc., New York, 1943; 221 pages, $2.75.

The success of *Queen of the Flat Tops* is reflected in this book by the same author. He not only gives the history of a famous Navy fighter squadron as seen through the eyes of the commander, Lt. Comdr. James H. Flatley, but surrounds their achievements by a background of air warfare in the Pacific from the battles of Midway and Coral Sea through the air and naval engagements by which Guadalcanal was won.

It is from such books that an intimate acquaintance is formed with the pilots who are winning such notable victories. Their courageous combat attacks on an enemy having superior numbers are adding laurels to the records made by airmen in this war. The part they have taken in the intricate strategy in the Pacific comes into clear focus in the chronologic accounts of naval engagements in which air forces had a predominant role.

The Suzy-Q, by Priscilla Hardison with Anne Wormser; Houghton Mifflin Company, Boston, 1943; 170 pages, $2.00.

The wife of the pilot of this famous B-17 tells the story of its epic flight around the world, its combat exploits, and its safe return home. Interwoven with the history of the plane are sketches of its crew and their observations on the events they saw in Java, Australia, and the Southern Pacific. It abounds with human interest as well as the spirit of the Air Forces. After reading this book the reader will be well informed about the duties and qualifications of each member of the crew of a Flying Fortress.

The Russian Army, by Walter Kerr; Alfred A. Knopf, New York, 1944; 257 pages, $2.75.

This book destroys the legend that little is known about the Soviet Army or its officers. This observing correspondent gives enough biographic information about the leading military figures in the Russian war to make them real poeple instead of names. The organization of the military command, from the supreme command under Stalin down to the guerillas, is described in detail and gives understandable reasons why there has been such secrecy about military operations

The author's admiration for the continuous offensive of the Russian infantry and artillery is not so strong for its aviation and cavalry. He admits that it is almost impossible for a foreigner to write much about the Red Air Force but leaves the impression, spread by other observers before the war, that while the pilots were excellent the equipment was not so good as the German and British airplanes. They excelled in the cold of the winter when they could use skis. In spite of limitations there is an excellent description of the leaders and airplanes of the Red Air Force.

The battles of Moscow and of Leningrad are followed in great detail. Allied aid is emphasized and the prediction is made that when the time is opportune Russia will be at war with Japan.

Ammunition, by Melvin M. Johnson, Jr., and Charles T. Haven; William Morrow and Company, New York, 1943; 361 pages, $5.00.

The makers of guns blame malfunctioning on the cartridge makers, the latter criticize the former, and the soldier swears at both when his gun jams. This encyclopedic work on the cartridge will give users of arms a clearer understanding of the historic development of ammunition, its characteristics and functions. Numerous tables give complete data on the ballistics and other necessary information about the cartridge. The contents of the book will be a useful addition to any aircraft gunner's course of instruction.

From Hell to Breakfast, by Carl Olsson; The Macmillan Company, New York, 1943; 143 pages, $2.50.

A series of stories of British pilots and other service men in the different commands. The correspondent-author has tried to catch the spirit of each man by using his own words as nearly as possible. The result is vivid tales of bombing, patrol, ferrying, and fighting. An unusual chapter is about an antiaircraft command and how it operated in a night "blitz." The stories are short, told mainly by men who are doing some of the war's less publicized jobs. For this reason the book takes the reader out of the beaten path of war tales.

Dilbert, by Lt. Robert C. Osborn; Coward-McCann, Inc., New York, 1943; $1.75.

A series of cartoons created for the Navy Department. By showing what not to do in an airplane, the pictures indirectly show air force cadets what they should do.

Military Japanese, by Yukuo Uyehara; P. D. and Ione Perkins, South Pasadena, Calif., 1943; 85 pages, $2.50.

A manual on the Japanese language, published for the Armed Forces, contains the essentials of Japanese, particu-

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larly those terms necessary when asking military questions and examining captives. The manual is divided into three sections covering language lessons, helpful material for interpretation and translation, and an English-Japanese dictionary of military terms.

Die Korrosion Metallischer Werkstoffe (The Corrosion of Metals); edited by Oswald Bauer, Otto Kroehnke, and Georg Masing; Verlag von S. Hirzel, Leipzig, 1936–1940; published and distributed by authority of the Alien Property Custodian by Edwards Brothers, Inc., Ann Arbor, Mich., 1943. Vol. I, Die Korrosion des Eisens und Seiner Legierungen (Corrosion of Iron and Its Alloys), 560 pages, $13.65; Vol. II, Die Korrosion von Nichteisenmetallen und deren Legierungen (Corrosion of Non-Ferrous Metals and Their Alloys), 901 pages, $22.50; Vol. III, Der Korrosionschutz Metallischer Werkstoffe und ihrer Legierungen (Protective Measures Against Corrosion of Metals and Their Alloys), 615 pages, $14.50; Set, $49.75.

In these volumes corrosion is understood to be a destruction of the metallic body which starts on its surface under the nonintentional influence of chemical agents. A distinction is made between intentional and nonintentional influence, the former inferring deliberate exposure for research purposes. The scope of these books is limited to the treatment of nonintentional corrosion. The subject is treated in great detail, defining the different kinds of corrosion, the chemical reactions taking place, and other physical phenomena.

Analysis and Design of Airplane Structures, by Elmer F. Bruhn; John S. Swift Company, Inc., Cincinnati, 1943; $4.50.

The third edition of a book originally published under the title *Airplane Structural Design* contains some additional material. Revisions have been made in the chapter on the design of steel and aluminum-alloy tubes as column and tension members. These revisions were made by permission of The Aeronautical Board, by using the latest recommendations of ANC-5.

The book represents material issued by the author in the form of notes to his students in beginning classes in airplane structure, comprising more than 175 example problem solutions, with over 1,000 figures and sketches intended to help explain the basic theory, as well as the solutions and the results of the solutions.

The first few chapters of Part A consist of a review of statics, with emphasis on the aeronautical connection. The remainder of Part A deals with more advanced applications of the fundamentals of statics and continuity, with many applications to typical airplane problems. Part B summarizes the general information and theories for determining and estimating the buckling and ultimate strength of thin sheet units. Part C deals with the application of the theory and information in Parts A and

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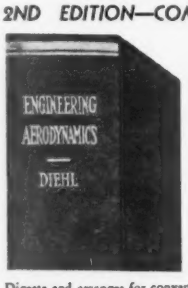

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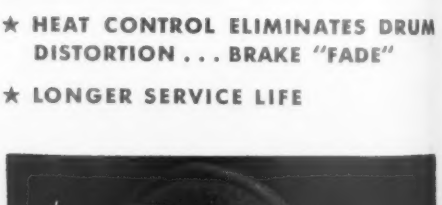

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The Transport License Method, Text N. 1, The Airplane, by Frederick B. Thompson; Thompson Aviation Publishers, Detroit, 1943; 127 pages.

The third edition of a book intended to be a practical study of the airplane. Its specific purpose is to enable a newcomer to begin a comprehensive study of airplanes and follow it in logical sequence. The student's point of view is carefully considered. To stimulate interest and provide a check on the student's progress, self-examination is provided in groups of questions. These are numbered to guide the student straight to the section where the answer may be found in a plain statement or may be determined by analysis. The final pages are devoted to a glossary of aeronautical terms. The book is mimeographed and is illustrated by many sketches and drawings.

Cross-Index of Chemically Equivalent Specifications and Identification Code; General Motors Corporation, Detroit; 31 pages.

This cross-index of specifications was initiated at the request of the United States armed services and developed by General Motors and other industrial concerns in cooperation with national, technical, and trade organizations.

It is intended to be of assistance to those engaged in translating bills of materials and specifications into terms of industrial and raw-material requirements. A code system is used to designate the specifications of various agencies of the U.S. Government and several engineering societies.

Part I presents the exact chemical analysis of the specifications; Part II lists the specifications of the various organizations in order, and the code number identifying the group to which each specification number is indexed; Part III is a numerical listing of the code numbers and their nominal compositions.

Second Shift, by Phillis Crawford; Henry Holt and Company, New York, 1943; 211 pages, $2.00.

A story depicting the experiences of a girl who, wishing to help the war effort, secured a job in a plant making aircraft parts. The book represents the actual first-hand experience of the author, who spent some months as an employee of a war plant making instruments.

Heat Transfer Bibliography, by F. C. Vilbrandt; Virginia Polytechnic Institute, Blacksburg, Va., 1943; Engineering Experiment Station Series No. 53, 72 pages.

A bibliography, prepared by the Engineering Experiment Station, of published material on the subject of heat transfer. The period covered ranges from January, 1908, to December, 1942.

Stock Clerk's Manual, prepared by Gordon Brock, edited by Leroy Smith Davis; Airlines War Training Institute, Washington, D.C., 1943; 90 pages.

A manual prepared for the instruction of air-line stock clerks, maintenance crews, and shop personnel. Among the many subjects dealt with are the grouping of parts, inspection, storage, the receiving department, the shipping department, stock classification, special airplane parts, aircraft standardization, code numbering, and information that will assist in the identification of commonly used parts.

Radio and Instrument Flying Instructor Manual, by Charles A. Zweng and Allan C. Zweng; Pan American Navigation Service, North Hollywood, Calif., 1943; 252 pages, $4.00.

A book written especially to prepare the pilot for taking the government examination for instrument rating is now in its fourth edition. These examinations include new typical "multiple-choice" examinations covering weather maps, meteorology, navigation, and Civil Air Regulations. The book contains the examination for the radio telephone operator's permit, which is required for "instrument rating."

Aerodynamics; Aircraft Structure and Power Plant; Meteorology; Navigation; American Education Press, Inc., Columbus, O., 1943; $0.27 each.

Four books on aeronautics are contained in the "Modern Aeronautics Activity Text" series. Each book contains 64 pages of test material, activities, problems, and questions.

Book No. I, *Aerodynamics,* explains the principles of flight with the aid of illustrations and diagrams.

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Book No. III, *Meteorology,* furnishes information on the weather in easily understood language.

Book No. IV, *Navigation,* explains piloting, dead reckoning, and celestial and radio navigation.

Those Were the Days, by Edward Ringwood Hewitt; Duell, Sloan and Pearce, New York, 1943; 318 pages, $3.00.

In this especially interesting autobiography of an old New Yorker may be found two aeronautical references. The first gives the experiments of Peter Cooper, the famous founder of Cooper Union, who tried to make an explosive engine that he proposed to use in a flying machine in place of a steam engine. He used terchloride of nitrogen for the explosive. Not satisfied with using a metal cylinder, he made a glass cylinder. It shattered at the first explosion and injured one of his eyes.

The second and more interesting reference is to Mr. Hewitt's association with Hiram Maxim when Maxim was constructing his flying apparatus. He was with Maxim for two summers and tested propellers and wing sections and steam engines. He gives many personal details not found elsewhere which will add to the historical background of flying.

The book is full of anecdotes of famous people of the last 50 years: Carnegie, Lord Kelvin, the elder Morgan, the Sultan of Turkey, and political figures of the period. The book gives an excellent idea of how the leading families of New York lived in the early days.

The Sky Is My Witness, by Capt. Thomas Moore, Jr.; G. P. Putnam's Sons, New York, 1943; 135 pages, $2.00.

Carrier Combat, by Lt. Frederick Mears; Doubleday, Doran and Company, Inc., Garden City, N.Y., 1944; 156 pages, $2.00.

These two books complement each other, since they are about naval action in the same areas—one as seen by a torpedo-plane pilot and the other by a marine captain who flew a dive bomber.

Capt. Moore's book is a personal biography and diary of his training and his participation in the Battle of Midway with the squadron commanded by Major Lofton Henderson, in whose memory Henderson Field on Guadalcanal was named, and later in action from Guadalcanal where he was injured and invalided home. As the story of a New York policeman's son who made a fine record as a pilot, it is an excellent human-interest account of Marine piloting.

Lt. Mears's book gives an excellent insight into the operation of an aircraft carrier. He was a member of the famous Squadron 8 operating from the aircraft carrier "Hornet," both sections of which made traditions of heroism which will always be part of the Navy's proudest annals. He flew at Midway and from Henderson Field at Guadalcanal, and his sketches of his fellow pilots give a vivid cross section of Navy air personnel.

Road to Tunis, by David Rame; The Macmillan Company, New York, 1944; 296 pages, $2.00.

The author of this book has written a detailed account of the military operation in North Africa, but those seeking to learn about the part played by military and naval aviation in that area will not find much to interest them. Anyone reading the book would receive the impression that the air forces were of little importance. Much credit is due to the ground forces that won such a decisive victory, but it would seem proper to give the pilots some credit.

Russian Cavalcade, by Albert Parry; Ives Washburn, Inc., New York, 1944; 334 pages, $3.50.

Few people can understand fully the present victorious onrush of the Soviet Armies without some knowledge of the history of Russian wars. The author was born in the Cossack country and gives a detached record of the wars that preceded the present attack. In 1760 the Russians marched into Berlin. They swept into Italy. They resisted

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Principles and Practice of Aviaton Medicine, by Harry G. Armstrong; The Williams & Wilkins Company, Baltimore, 1943; 514 pages, $6.50.

This revised edition of a book on aviation medicine written for flight surgeons gives information on the selection and care of aviators, the physiologic and emotional effects of flight on man, and what remedies exist for adverse conditions. New information is included on the selection of flight surgeons, dark adaptation, aero-otitis media, false sensations in flight (especially in "blind" flight), pathology of acute altitude sickness, oxygen administration and inhalation, protection against effects of acceleration, war anxiety states in airmen (with case histories), and aerial evacuation of emergency cases.

Readings for an Air Age, edited by Harold G. Merriam, John E. Moore, and Baxter Hathaway; The Macmillan Company, New York, 1943; 420 pages, $2.00.

This training course in oral and written thought has been compiled to meet the needs of men in the armed services who are taking work in English in American colleges and universities. The editors have chosen material that for the most part has a direct bearing upon the kind of work these men are doing in their courses and which will allow for the incidental acquisition of a vocabulary appropriate to their interest. The articles, essays, and speeches printed in the last half of the book deal with broader problems than those handled in the first half. These speeches and essays are intended to provide materials for a study of some of the more sober and understanding interpretations of things that are happening.

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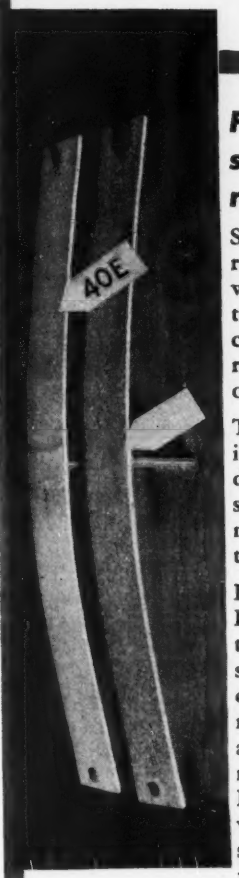

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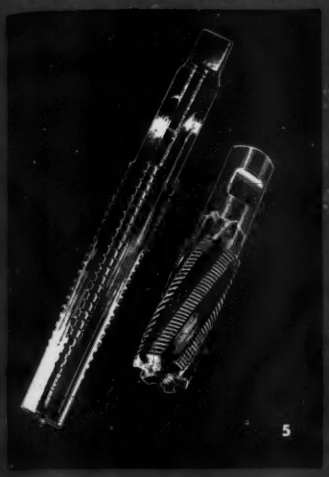

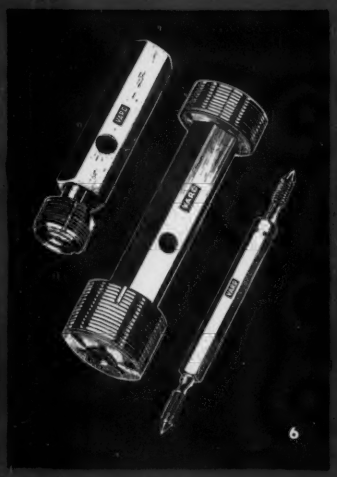

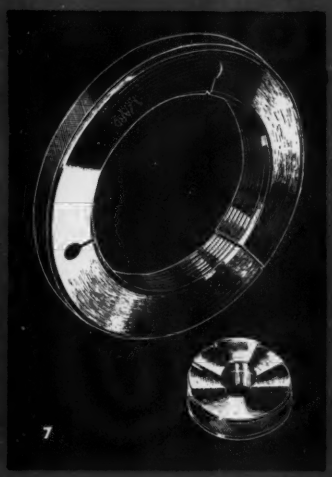

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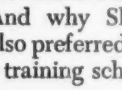

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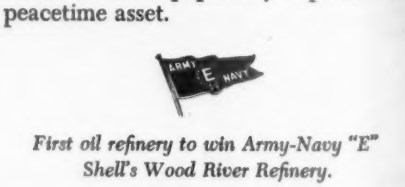

Experimental Stress Analysis, edited by C. Lipson and W. M. Murray; Society for Experimental Stress Analysis, Cambridge, Mass., 1943; 198 pages.

This book is the report of the Society for Experimental Stress Analysis and gives the papers presented at the Seventeenth Eastern Photoelasticity Conference and Experimental Stress Symposium.

Twenty technical papers are included. Those directly connected with aeronautical engineering subjects are: "Distortion and Stresses in Connecting Rod Bearings," by C. Lipson; "Vibratory-Stress Measurements in Aircraft Engine Parts," by Maurice Tucker; "The Application of Experimental Stress Analysis to Engine Design," by C. Gadd; "Factors Involved in Improving Aircraft Engine Pistons," by R. G. Anderson.

Aircraft Recognition, by R. A. Saville-Sneath; published jointly by *The Infantry Journal* and Penguin Books, Inc., New York, 1943; 252 pages, $0.25.

A third and revised edition of a book on how to identify British, German, and Italian airplanes brings the information up to July 20, 1943. Material on the points of recognition of aircraft has been revised in accordance with the latest battle experiences and advances in the theory of identification. Silhouettes and descriptions of about 30 additional aircraft are included in the new edition.

Maintenance Arc Welding; The James F. Lincoln Arc Welding Foundation, Cleveland, 1943; 234 pages, $0.50.

A set of 25 selected papers on applications of the arc-welding process in the maintenance of metal equipment and structures comprises the second book developed from the 1940–1942 program of the Lincoln Foundation. The papers were selected on the basis of originality, value of information, and thoroughness in treatment of the subject matter. Papers considered by the publishers to be too lengthy for complete reproduction have been briefed without loss of pertinent text matter or illustrations. A brief summary at the beginning of each chapter serves as a guide to the content of the paper.

A.S.T.M. Standards on Plastics, sponsored by A.S.T.M., Committee D-20 on Plastics; American Society for Testing Materials, Philadelphia, 1943; 431 pages, $2.00.

One of a series of special compilations of A.S.T.M. standards relating to specific materials, this book was published for the purpose of presenting under a single cover what the Society believes would be of importance to those interested in plastics. It contains specifications, methods of testing, nomenclature, and definitions of plastics.

Russian-English Dictionary of Meteorological and Related Terms; U.S. Weather Bureau in cooperation with Weather Information Service, Headquarters Army Air Forces, 1943; 65 pages, $0.25.

A glossary of Russian meteorologic and related terms for use in translating meteorologic messages and publications contains terms in common usage in meteorology, climatology, and related fields. As a further aid in transliterations, the book gives the Russian alphabet, numerical systems, calendar, a list of words used in titles of Russian meteorologic publications, a list of isolines with definitions, and terms encountered on maps.

Filter Measurements of Solar Radiation at Blue Hill Observatory, by Edmund Schulman; Harvard Meteorological Studies, No. 7; Blue Hill Meteorological Observatory, Milton, Mass., 1943; 68 pages, $0.90.

A review of accumulated observations on the measurement of the intensity of normal-incidence radiation, both in the entire solar spectrum and in selected regions as determined by filters. In addition to the text matter, tabulated data are appended giving the results of extended observations. Table 1 contains over 900 sets of observations through red and yellow filters, as well as unfiltered readings, from July 24, 1934, to August 11, 1939. Because of a change in filters the data have been revised in order to make the entire set homogeneous. Only those observations were considered in which the recorder trace indicated an especially steady atmosphere, so that Table 1 represents a highly selective series.

Table 2 lists some 350 sets obtained during 1940 with new filters. For completeness, these include all screenings, although in some cases sky conditions were less satisfactory for radiation observations than those for the selected screenings of Table 1. Since the primary objective of the report was to assemble the measurements into a homogeneous group, the elimination from the data of the numerous errors is discussed at considerable length. Only preliminary conclusions based on the data are included.

Military and Naval Recognition Book, J. W. Bunkley; D. Van Nostrand Company, Inc., New York, 1943; 444 pages, $2.50.

A fourth revised edition of a book on the organization, functions, uniforms, insignia, and medals of the United States and foreign armed forces. It gives this information about all of the armed services and some of the civilian units of the United States Government, with added features on the Navy and information on the women's branches, as well as the rank, etiquette, and customs of each service. Combat aircraft markings of the various nations are included.

Airman's Meteorology, by Hubert A. Bauer; Denoyer-Geppert Company, Chicago, 1943; 28 pages.

A teacher's manual for use with the Denoyer-Geppert meteorology series. It is intended to provide an understanding of charts that present in visual form the subject matter needed for courses in meteorology. Information is given on charts covering pressure and winds, atmosphere and clouds, air masses and fronts and on weather maps.

The four charts are printed on a large scale and with distinguishing colors. A fifth map, accompanying the charts and the book, covers the polar air-age world. The meteorology charts are priced at $6.25 each.

Handbook of Federal World War Agencies and Their Records 1917–1921; U.S. Government Printing Office, Washington, D.C., 1943; 666 pages, $1.25.

A handbook containing information concerning the functions and records of agencies of the United States Government that contributed to the participation of the United States in the first World War. The agencies dealing with aeronautical matters are listed in their alphabetical places, with appropriate cross references, using the designations that were current during the periods of operation of the respective units. Brief paragraphs give the history and functions of each agency and the present location of its records. Included in the volume is a selective bibliography of general works on Federal agencies and an appendix containing a hierarchical list of agencies described in the text. The book constitutes Publication Number 24 of The National Archives.

United States Directory of Registered Professional Engineers; Lewis Historical Publishing Company, Inc., New York, 1943; 646 pages.

This biennial directory contains a general alphabetical list of registered professional engineers of the United States, with addresses, as well as a geographic list of these engineers. Other sections of the directory cover the officers, purposes, member boards, and publications of the National Council of State Boards of Engineering Examiners; membership of state boards; National Bureau of Engineering Registration; digest of state laws governing the practice of professional engineering; engineers issued Certificate of Qualification by the National Bureau of Engineering Registration; and the symbolic key to state lists using such symbols.

Air Force Airs, compiled by Mildred A. Yount; Army Air Forces Aid Society, Washington, D.C., 1943; 134 pages.

A booklet of popular songs, hymns, and familiar tunes that airmen of the Army Air Forces have been singing. The musical scores of many of the tunes are reproduced, and the lyrics of others are given.

Cocky, The Little Helicopter, by Jack Alden; Rand McNally & Company, Chicago, 1943; $1.00.

This story about an imaginary helicopter is written for children. The book translates into language suitable for small children some of the performance characteristics attributed to helicopters for future civilian use.

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Photogrammetry, edited by O. von Gruber; American Photographic Publishing Company, Boston, 1942; 454 pages, $6.00.

An English translation of a German book on the measuring of photographs and the plotting of maps therefrom is intended to be of interest to students wishing to acquire a knowledge of developments in Mid-Europe and elsewhere. The original text was compiled from lectures delivered during a vacation course held in Jena in 1929. The following points of view determined the selection of the chapters to be considered: limitation of photogrammetry in the service of topography; representation of a coherent review of the principles, methods, and instruments of photogrammetry; examination of the utility of various instruments and methods.

Library Accessions

ANC-1 (1), Spanwise Air-Load Distribution, Army-Navy-Commerce Committee on Aircraft Requirements; U.S. Government Printing Office, Washington, D.C., 1938; 81 pages, $0.60.

An instruction book covering the application of stress analysis methods to the determination of span-load distribution in the design of airplane wings.

A Handbook for Drivers' Corps Members, Office of Civilian Defense; U.S. Government Printing Office, Washington, D.C., 1942; 123 pages, $0.15.

For members of the civilian drivers corps, this is a handbook on their duties and qualifications, the conservation and maintenance of their cars, emergency repairs, special problems in motor corps driving, night and black-out driving, the use of maps, and the operational scheme of the corps.

The Block Plan of Organization for Civilian War Services, Office of Civilian Defense; U.S. Government Printing Office, Washington, D.C., 1943; 12 pages, $0.05.

A plan is outlined for securing complete mobilization on the home front with the city block as the unit of organization. Suggestions are based upon the experience of cities which have used the plan.

Dakar, Outpost of Two Hemispheres, by Emil Lengyel; Random House, New York, 1941; 312 pages, $2.00.

The strategic importance of Dakar is demonstrated in this book on the past, present, and future of the West African port.

Civil Aviation in Brazil, Its Beginning, Growth, Present State; "Graphicars," São Paulo, Brazil, 1938; 44 pages.

The history of civil and commercial aviation in Brazil is traced from its inception to its present status.

What the Citizen Should Know About the Navy, by Hanson W. Baldwin; W. W. Norton & Company, Inc., New York, 1942; 219 pages, $2.50.

Second and revised edition of a comprehensive interpretation of the U.S. Navy, for the civilian. Navy organization, personnel, equipment, training, applications, and fighting principles are explained.

(*Continued from page 61*)

human and industrial relations and provides an understanding of the policies, plans, methods, and problems of management. It includes:

A. Foremanship and Supervisory Courses.

B. Training-Within-Industry Courses. (1) Job Instructor Training, (2) Job Methods Training, and (3) Job Relations Training.

C. Round Table Conference Training Program. A series of special conferences on selected subjects other than purely technical production meeting matters. Planned agenda is used. Typical subjects would be company policies and procedures, the union contract, Selective Service problems, etc.

Passive Defense Training

Training of a protective and preventive service nature.

A. First Aid Training Conducted by the Medical and Safety Departments.

B. Guard Training.

C. Fire Brigade.

Subcontractor Training

Training to acquaint the various subcontractors with prime contractor methods and procedures. May be carried on at the prime contractor's plant, at the vendor's plant, or by pamphlets and instructions.

Customer Airplane Maintenance and Operation Training

Training designed to acquaint company and customer mechanics with the fundamental operation service and maintenance requirements of the specific airplane. May vary in length from 10 days to several months.

Auxiliary Training Aids

In order to facilitate the smooth and proper functioning of the entire program, certain aids and media must be provided for both instructor and trainee.

A. Library Research Service. Plant library facilities should be provided in which selected books, periodicals, and other data covering the related subjects of the training program are available for any employee's use during out-of-work hours. A librarian should be available to provide reference service and data, lists of standard texts, periodicals, etc. The library should also be a clearing house for all outside informational agencies regarding training.

(1) Reproduction of selected articles and preparation of training papers and articles, as the need arises, for distribution to all interested personnel.

B. Visual Aids. It is through such visual aids as charts, pictures, films, perspective drawings, etc., that the best results are often achieved. Numerous films are available from the public agencies and for loan from major industrial concerns. Visual aids should be used at every opportunity.

C. Aptitude and Selection Tests. An aid to evaluate the work done in the training program, and to eliminate wasteful training by preselection of trainees.

D. Instructor and Conference Leader Training. Necessary provisions should be made for the development of the instructors and conference leaders necessary for the various phases of the program.

CONCLUSION

Evaluate your training by considering the following pertinent questions:

(1) Are we taking advantage of the free educational facilities of municipal, state, and federal agencies?

(2) Have we burdened our training department with the cost of instructor personnel that might have been obtained free?

(3) Are we making full use of auxiliary aids such as: library service, films, charts, production illustrations, and aptitude and performance tests?

(4) Are we under the illusion that the imparting of knowledge and development of skills is the only function of our training program? Are we ignoring training for the proper development of *attitudes* and *habits?*

(5) Are we training the wrong people in the wrong things at the wrong time?

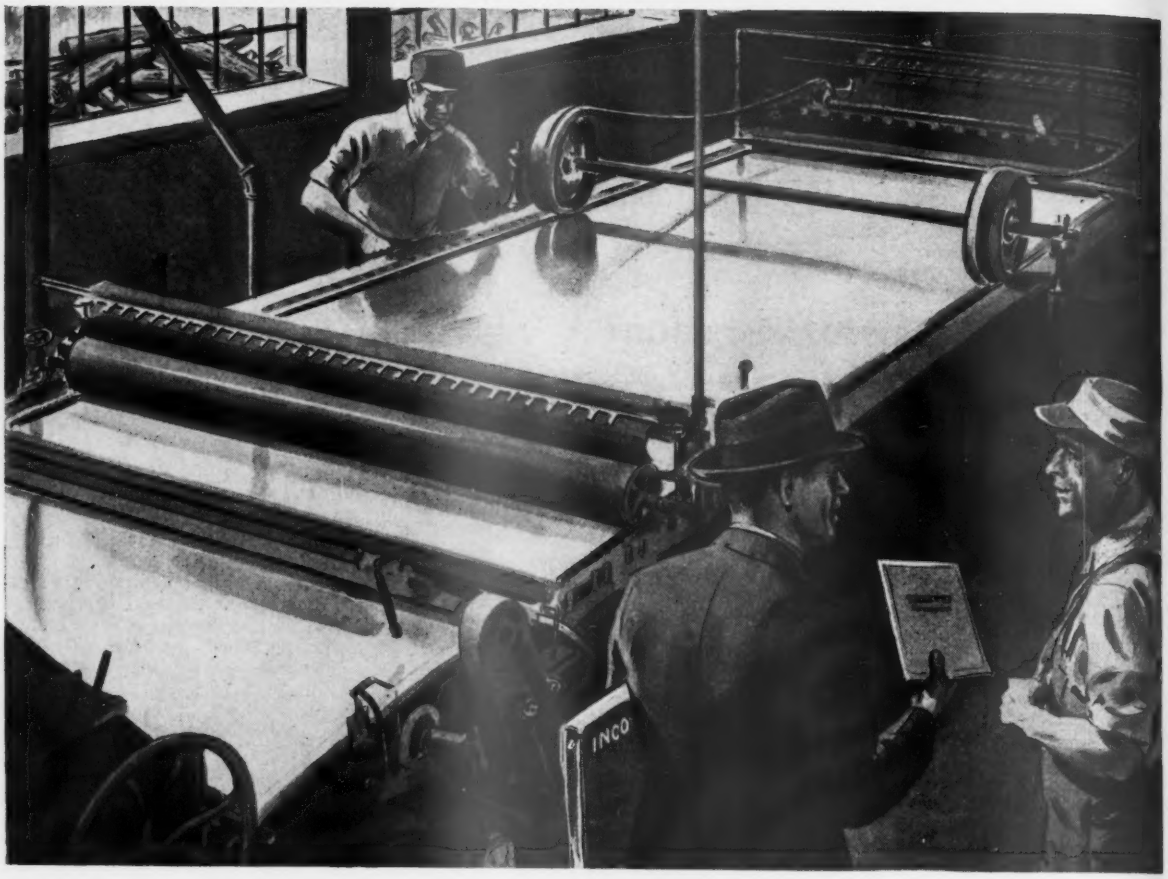
(6) Are we overtraining, thereby creating discontent, since there are perhaps a limited number of jobs available?

(7) Are we training so as to make possible the best use of available man power and woman power?

(8) Are we under the impression that all training should be on the employee's own time?

(9) Do we realize that to achieve desired production results we should be willing to have employees undergo training on company time?

(10) Is our training program designed to facilitate and provide adequate means of upgrading according to an established pattern?



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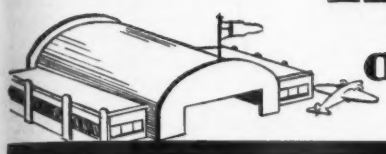

Sister Firms in Britain

English Counterpart of Martin Plant Keeps Baltimores Flying. An article describing one of the aircraft factories of Cunliffe Owen, Ltd., where English women and a few men can be found working on the same R.A.F. Baltimores that were built by American workers at the Glenn L. Martin factories. This plant is one of the many British factories now serving as sister firms to American manufacturers building for the R.A.F. *The Martin Star,* December 7, 1943.

Air-Temperature Control

Temp-Turb Temperature Control is a booklet of 8 pages describing an air-operated, thermal sensitive device for providing a directed torque or rotation which depends on the temperature of the air that operates it. A typical installation of the temp-turb control is for controlling the temperatures of the air entering an airplane heating system. It can be used also to control the temperature of ducted air in any application.

The operation of the instrument is described, suggestions are made for its installation, and its characteristics are outlined, illustrated by photographs, drawings, and charts. *General Electric Company.*

Heat-Treatment of Fighter Parts

Heat Treat for Metals . . . A description is given of how the metal parts of the Airacobra fighter are not only made more workable but are also given added strength by heat-treating operations carried out in Department 66 of the Buffalo plant. *The Bellringer,* December, 1943.

Early History of Aviation Medicine

Origin of Aviation Medicine. Victor Robinson. In article describing how aviation medicine originated and outlining its early development, the writer tells about early chemical experiments conducted by Henry Cavendish. It is stated the work of Cavendish was the chemical prelude to aviation medicine and that his discovery of hydrogen made ballooning practicable. Information is given on early balloon ascents which advanced the knowledge of physiologic reactions at high altitudes.

The work and medical apparatus developed by Paul Bert, who is called the father of aviation medicine, is described. Illustrations of apparatus employed by him include a mercury pump for extracting gas from blood, a device for shaking up the blood with air under high atmospheric pressure, a syringe for collecting blood, and a twin-compartment altitude chamber. Jourdanet's apparatus for the therapeutic use of compressed and expanded air also is illustrated. *Ciba Symposia,* December, 1943.

Republic's New House Organ

The Thunderbolt is a new house magazine which Republic Aviation plans to issue periodically. The magazine is intended to give its readers a review of the company's activities. It will be dedicated to the company's hopes for the future and its desire to serve the best interest of American aviation within the field of its specialized experience in high-speed, high-altitude flight.

The first number of the new magazine includes reviews of the development and production of the P-47, photographs of the Thunderbolt in action, pictures of company executives and of Army Air Forces officers, stories and pictures about different plant departments and visitors, and a vision of future commercial aviation. *Republic Aviation Corporation.*

Manufacturing Equipment

Tools for Tomorrow. How the introduction of multipurpose machines and the development of mechanized manufacturing methods have made possible increased aircraft production and improved airplanes is outlined. A description is given of the manufacturing equipment used in shops of the Wright Aeronautical Corporation. Future developments in machine-tool equipment are discussed. *Trade Winds,* December, 1943.

Study of Absenteeism

What Management Can Really Do to Reduce Absenteeism is the title of a 27-page pamphlet presenting the results of an extensive study of the subject made by an organization devoted to research into problems of business management. Nation-wide and localized surveys were made and views were obtained from both employers and employees. The findings were correlated with what has been printed on the subject. *George S. May Business Foundation,* Chicago.

Testings of Bearings

Anti-Friction Bearings for Airplanes. Capt. Joseph P. Vidosic. The testing of antifriction bearings for such aircraft mechanisms as pulleys, bellcranks, and universal joints is discussed. It is explained that three distinct steps are involved in the complete qualification procedure: (1) laboratory tests, (2) fabrication control, and (3) service experience. The principal part of the article is devoted to laboratory tests. *The Bearing Engineer,* October, 1943.

Aviation Progress

The Wings Grow Stronger. The history of the Wright Aeronautical Corporation and its predecessors is traced in an article on the progress of aviation which opens with a reference to how the Wright brothers increased the power of their 8-hp. home-made engine to 35. Mention is made of Glenn H. Curtiss' contributions to aviation, the first flight across the continent, and the advances in aviation up to the beginning of World War I. Figures are given on the number of aircraft engines produced during the first World War. The remainder of the article is largely devoted to an outline of the expansion and development of the Wright organization. Illustrations show aircraft engines built during the twenties, thirties and forties. Charts reveal advances in aircraft and aircraft-engine performances. *Trade Winds,* December, 1943.

Airplane Jacks

Mechanical airplane wing jacks for use in the repair of landing gear struts and undercarriages are described in an 8-page bulletin. The jacks are designed to avoid "creeping" or settling. The line includes electrically operated and manually operated jacks, in portable and collapsible or stationary models. *The Duff-Norton Manufacturing Company,* Pittsburgh.

Flight Operations Department

The Test-Pilot Gets the Facts. The functions of Lockheed's Flight Operations Division are outlined. It is the triple responsibility of this division to check new or serviced aircraft in actual flight, train test pilots, and deliver aircraft. Particular attention is paid in the article to the part of the work concerned with test flying. *Global Service Log,* Third Quarter, 1943.

Hydropresses

Grizzly's Den. Harvey Parker. Although it deals not only with the equipment in Douglas Aircraft's hy-

draulic press room but also the personnel, the major portion of this article is devoted to a description of two hydropresses. The construction, operation, and power of each is noted, together with the Guerin process which is employed for the forming and cutting of sheet metal in the presses. One of the discussed hydraulic presses is reported to have a 5,000-ton pressure limit, the other 2,000 tons. *Douglas Airview*, December, 1943.

Bolt and Screw Manufacture

Fasteners by the Million. C. F. Newpher. The quantity production of screws, nuts, bolts, rivets, and other fasteners for holding finished products together is described. Various manufacturing operations are illustrated. Drawings of some typical fasteners are shown. One of these shows the design of a special dome nut for bullet-sealing aircraft fuel tanks. *Steel Horizons*, Vol. 5, No. 5.

Production Improvement

Additional sheets have been published for insertion in the Curtiss-Wright Production Improvement Bulletin. They cover self-adjusting vise shims, tube bending by the hose and cable method, a collect-type milling fixture, and materials handling and the storage of heavy stock. *Curtiss-Wright Corporation, Airplane Division.*

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"The Buccaneer Route"

Service Keynotes National Airlines' Expansion. The history and service record of National Airlines are reviewed briefly. Data are given on the establishment and expansion of the "Buccaneer" routes, the company's equipment, its participation in the work of the Air Transport Command, and the volume of additional wartime traffic it handles. Contemplated extensions of its service are also reported. *Global Service Log*, Third Quarter, 1943.

Founders of Aviation Medicine

Research in aviation medicine carried out by the A.E.F. is described and information is given on some of those responsible for advances in military aviation medicine. The early aeronautical work of Chanute and the Wright Brothers is referred to.

A history is given of the accomplishments of Theodore Charles Lyster, who is called the father of aviation medicine in America. Other leaders in aviation medicine are named and their work is reviewed. Illustrations include the medical research laboratory of the Third Aviation Instruction Center of the A.E.F., one of the rooms in this laboratory, and the laboratory's low-pressure tank. *Ciba Symposia*, December, 1943.

Mechanized Manufacturing

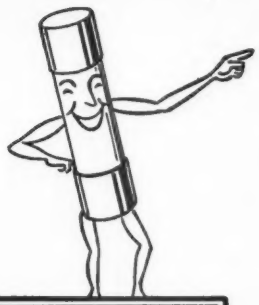
Machines that Make Machines! The mechanization of manufacturing equipment, as typified by machines used at the Wright Aeronautical plants, is examined. The following are among the equipment described: the Greenlee Transfer, a fully automatic machine which does the work of 46 conventional machine tools and performs its own transporting of parts from "station" to "station"; automatic metallizing equipment; the Scandia Torque machine for tightening crankshaft bolts to an exact foot-pound tension; a dynetric balancer that indicates the exact amount of any unbalance through the use of electronics; a device for forcing wet mold sand into forms; and the Cam-O-Lap machine used to give fine surface finish to engine cams. *Trade Winds*, October, 1943.

Cartoon Films for Training

Drawing for Full Houses. Helen Call. A brief illustrated description of how cartoon films, which might be called animated production illustrations, are used to show the way to fly and service the Flying Fortress. *Boeing News*, December, 1943.

Pictures for Training

It's All Done with Pictures! Explaining that when the war started there was not time to put new employees required for war work through an engineering school, this article tells how pictures were used to do the job. Aircraft manufacturers took over the work of supplying the Army and Navy air units with pictures for flight training,



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Out of the Mouths of Ugly Ducklings

FROM ATTU to Africa, from Kiska to Sicily, from Munda to New Britain, LSTs, vital units of America's great fleet of landing craft, have won laurels in a new art of warfare.

These "Ugly Ducklings," as they are known affectionately to the men who work them beachward in the face of enemy gunfire, are one of the most startling types of ship the war has produced.

Born of American ingenuity along the banks of the Mississippi, the LST (Landing Ship, Tank) was only on the drawing boards a mere two years ago. The first model was completed in October, 1942. Yet so vital are these "Ugly Ducklings" in today's amphibious warfare that production of landing craft has been given an overriding priority over all other urgency programs.

Knowing the vital importance of absolutely accurate navigation and trustworthy steering, our Navy equips every LST with the Sperry GYROTRONIC Compass, the famous Mark XIV. And as a result of experience gained in Africa and in the Pacific, the Sperry Electric Follow-Up Steering Control is specified for those currently being delivered to the Navy.

Such large numbers of these two precision devices (designed, developed, and manufactured by Sperry) are now being used that no one company can possibly produce them all. So, Multiscope, Inc., of Coffeyville, Kansas, is making the complete Steering Control for Sperry under subcontract, while the Dodge Division of Chrysler Corporation is helping to supply quantities of Sperry Gyro-Compasses, under prime contract to the Navy.

TODAY, this minute, these gallant LSTs are making history . . . landing tanks and men on enemy-held beaches . . . and landing them exactly where and when they are scheduled to be landed.

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service, and maintenance personnel. How the art group of an aircraft manufacturer was expanded to take care of the demand for illustrations for training is described. *The Beech Log*, December 17, 1943.

Additional N.A.S.C. Sheets

Sixteen additional sheets have been issued for the insertion in the National Aircraft Standards files. They cover plastic hose crosses, tees, unions, nipples, elbows, and coupling nuts. *National Aircraft Standards Committee.*

The Rubber Industry in War

An 80-page illustrated pamphlet titled *The Rubber Industry and The War* summarizes the war story of some 500 American rubber manufacturers. An account is given of the many problems of conversion faced and solved by the rubber manufacturer and the role he has played in war production. It is explained that the three production tasks were to make all rubber products essential to win the war, to make other "nonrubber" products that had to be made to win the war, and to make the rubber itself—synthetically. Sections of the publication describe how each of the three jobs are being carried out. *The Rubber Manufacturers Association, Inc.*, New York.

Hydraulic-Equipment Catalogue

Pressurized Power and Controlled Flow by Pesco is the title of a new booklet containing informative material for design engineers and others concerned with improved methods of handling liquids and utilizing pump power in their products or processes. The book presents pictorially the engineering and experimental-laboratory services, as well as the precision production facilities of the manufacturers who produce small compact, lightweight hydraulics, fuel pumps, air pumps, and related accessories. The past decade of aircraft development is reviewed in relation to the strides that have been made in pumping equipment offering new high standards of performance. Facilities and equipment resulting from meeting the demands of the aircraft industry are now offered for possible adaptation to other fields. *Pesco Products Company*, Cleveland.

Turbosupercharger Development

"They're Turbosupercharged" outlines the history and research activities connected with the development of the exhaust-driven turbosupercharger. The part played by Dr. Sanford A. Moss, who pioneered the development of the turbosupercharger, is described. The booklet explains the general construction of the turbosupercharger and tells how it differs from the geared supercharger. Some of the advantages of the turbosupercharger are listed.

Among the illustrations is a diagram showing the amount of power attained by the engines of a turbosupercharger-equipped plane at various altitudes from 10,000 to 50,000 ft. above sea level. *General Electric Company.*

Automatic Engine Controls

A new insert for the Simmonds Products Handbook consists of a reprint from an article titled "Engine Control Achieves Simpler Piloting," appearing November, 1943. It describes Simmonds automatic aircraft-engine controls. *Simmonds Aerocessories, Inc.*, New York.

Ball Bearing Service

A booklet on service procedure for ball bearings describes in simple terms the dismounting, cleaning, inspection, and remounting of ball bearings. It is designated as ND-A57 and is illustrated with drawings and photographs. *New Departure Division, General Motors Corporation*, Bristol, Conn.

Induction Heating Process

A revised booklet on a process of induction heating for the treating of steel parts shows recent installations of the process and a series of views of various types of parts easily treated by induction heating. Sections of the booklet cover the principles of induction hardening, heat-treating, brazing and soldering, normalizing and annealing, and heating for forging and forming. Other sections deal with carbide solution and superhardness. Tables and charts reveal hardness tests, power effects, etc. *Ohio Crankshaft Company*, Cleveland.

Models for Plant Layout

Scaled Models Expedite Plant Layout. Jeanne Lott. The use of three-dimensional scaled models to facilitate plant layout work is described. It is noted that the models used are not simply wood blocks but are shaped to show the type of equipment they represent. New techniques used in the building of these models are described. The models are portable, the entire construction being light. It is stated that the outstanding advantage of the models is the flexibility they lend to layout planning. *Fleetwings Arrow*, January, 1944.

Greater Engine Power

Cyclone 18. This article not only presents information on the design and construction of the new Wright Cyclone aircraft engine—an 18-cylinder, air-cooled radial engine of 2,200 hp.—but also interprets what the use of this powerful engine will mean in terms of increased load, range, speed, rate of climb, and striking ability for combat planes. In addition, its importance as a factor in postwar air transport is depicted.

Built in two banks of nine cylinders each, the Cyclone 18 is reported to have a displacement of 3,350 cu.in. Despite the high horsepower, it is said to create less drag than the original Cyclone engine with one-quarter the power, because of its improved cowling and 55-in. diameter. Some of its construction features include: aluminum-alloy cylinder heads and nitralloy steel cylinder barrels; use of a steel crankcase that permits taking more power from the engine than is possible with and aluminum case; use of lightweight magnesium in nose section and supercharger housings; and a low-ratio reduction gear system that enables the propeller at an average cruising speed to turn at only 600 r.p.m. *Trade Winds*, October, 1943.

Weight and Balance Recorder

Archimedes up to Date—Or How to Load a PBM-3 Mariner. A description is given of an automatic weight and balance indicator known as the Hydrobal, developed to facilitate the proper loading of flying boats. The instrument, the operation of which is based on hydrostatic principles, is stated to provide accurate and rapid readings of draft and trim angles, which are then plotted on a calibrated chart to obtain the loading weight and center of gravity of the aircraft. Recent refinements in the design of the instrument are described. *The Martin Star*, January, 1944.

Air Transport, 1933 Style

Cargo Planes? Yes—Ten Years Ago! Harmon A. Harris. A story of how Panagra planes flew ton-heavy machinery from Cuzco to Huanacopampa, in the Peruvian Andes, as early as 1933. The aircraft used were converted Ford trimotor passenger planes equipped with high-altitude, supercharged Wasp engines. With the interior of the plane stripped of its fittings, a hatch was cut in the fuselage so that pieces of machinery 8 ft. long by 4 ft. wide might be put aboard. Except for one on each side, windows were blocked with smooth sheet dural. A double-rail track was laid along the floor of the cabin so that it formed a rolling platform for the cargo's weight to be properly distributed inside the plane. *The Grace Log*, December, 1943.

Matériel

It Takes All These. A series of notes on the work of Douglas Aircraft's Matériel Division. Without detailing the procedure of the department, the article indicates the vast stores it must handle, the complexity of its job, and some of its special functions. *Douglas Airview*, December, 1943.

History of an Aviation Company

Yesterday's "Touch of Tomorrow." Richard H. Depew, Jr. The third section of a history of the growth and development of the Fairchild Engine and Airplane Corporation and its products relates the early sales of aircraft and the redesigning of the FC-1, with greater power, as the FC-1A. How the early models were developed and tested, how they were sold to individuals and to some of the pioneer air lines, and the establishment of regular production are recounted. Among other events noted are the delivery of two FC-2's to the

FLYING BEGINS

PHOTO COURTESY CONSOLIDATED VULTEE AIRCRAFT

ON WHEELS

On Hayes Wheels and Brakes—thousands of pilots and crews have taken off to begin their training, and landed after countless flights, to win their wings.

And whether on trainer, transport, fighter or bomber—pilots, ground crews and tech men know Hayes rugged reliability and easy maintenance means "Roger!" when it comes to wheels and brakes—both the famed Hayes Expander Tube and shoe-type brakes.

Western Representative: Airsupply Co., 5959 W. 3rd St., Los Angeles
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AIRCRAFT
WHEELS AND BRAKES

HAYES INDUSTRIES, INC. Home Office: JACKSON, MICHIGAN, U. S. A.

Department of Commerce, participation in Lindbergh's tour, and the first flight of a Fairchild seaplane. The seaplane test was accomplished by putting floats on the FC-2 on the day following its test flight as a landplane, it being stated that probably no other new airplane had been tested as a landplane one day and a seaplane the next. *The Pegasus*, January, 1944.

New Mechanized Assembly Line

Lockheed Answers the Call for More Lightnings! Some brief data on the new mechanized assembly line for P-38's and how it was installed in 8 days. Similar to those used in automobile production, the continuously moving conveyer is described as being arranged in the shape of a reversed "B." The planes move down one line, shuttle back in the opposite direction on the second, and the third carries them again the length of the final assembly hangar. Stock racks containing kits of the various parts to be installed run parallel to the moving lines. *Global Service Log*, Third Quarter, 1943.

Progress in Air Transport

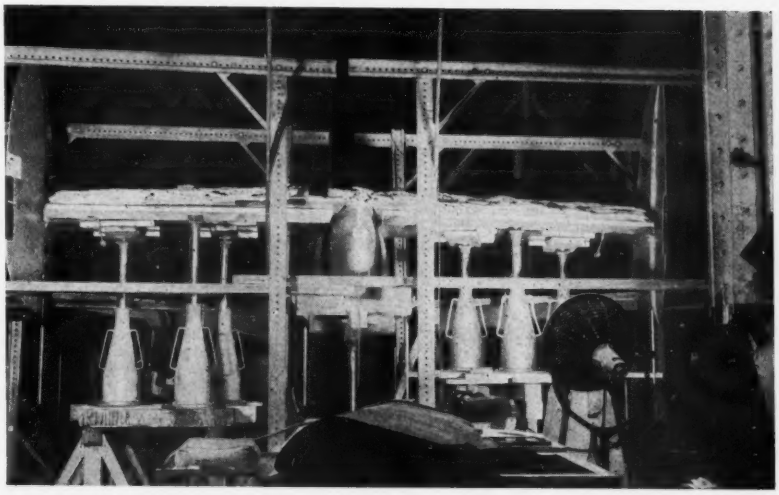
Air Transport Comes of Age. The progress in air transport is traced in an article discussing the expansion of the air lines and advances in the design of air transport planes. Particular attention is given to the increase in the power of transport planes. The introduction of multiengined planes is discussed. *Trade Winds*, December, 1943.

Air-Age Education

Air-Age Education Research. An article telling about the air-age educational research organization sponsored by American Airlines, which has been developed to function as a liaison agent between educators and the leaders in all fields of aeronautics. It is shown that instruction will have to be expanded in geography, economics, languages, political science, history, philosophy, and other subjects to meet the new conditions imposed by the growth of air transportation. *Flagship News*, December, 1943.

Electronic Applications

Electronics in Industry—Today! The role of electronics in industry is discussed and some of the applications of electronics not shrouded by war secrecy are outlined. While the importance of electronics in future industrial developments is emphasized, it is stated that no discussion of the postwar "age of electronics" should soar into the realms of the extravagant. Some of the immediate industrial fields into which electronic applications fit are listed. Reference is made to the use of radio-frequency heating in the plastics industry. The use of electronics in speeding the production of "Compregwood" aircraft propellers is mentioned. A rivet detonator for use on inaccessible aircraft parts is illustrated. *Steel Horizons*, Vol. 5, No. 5.



With the tail supported by hydraulic jacks, bags of shot weighing 10 lbs. each are loaded on the horizontal tail of the Fairchild AT-21 to test loads under varying conditions.

Static Tests on AT-21

Burlington-Built "GUNNER" Passes Severe Static-Ship Tests of Army. The recently released report of the Army Air Forces static tests applied to the Fairchild AT-21 indicates that the construction, in which molded plywood predominates, has successfully met the requirements. Conducted by the Structures Laboratory at Wright Field, the tests are given to all new designs ordered by the A.A.F. to prove the strength of every major part and assembly under conditions simulating actual flight. How the tests are applied is described, covering the apparatus used and the methods of measuring the stresses, including the point where the "ultimate load" is reached. *The Fairchilders*, December 10, 1943.

Thread Grinders

A 6-page bulletin, designated as No. 25, furnishes instructions for mounting a toolpost grinder and a thread-grinding attachment on lathes. Typical thread-grinding procedures are described. Complete helical-angle tables for U.S. Standard and Acme thread for settings on the grinder and dresser are given. Both Standard and Acme dressers are shown. A thread grinder in operation is illustrated. *The Dumore Company*, Racine, Wis.

Part-Time Work for High School Students

Boypower. An additional source of labor is noted in the employment of high-school students by the Ryan Aeronautical Company on a part-time basis.

Supplementary to the company's program of hiring high-school students during summer vacations, this scheme provides for the employment of selected students 4 hours per day during the school term. It is reported to be extremely successful. *Ryan Flying Reporter*, November, 1943.

Engine Service Bulletins

Service Bulletin No. 25 covers approved spark plugs and spark-plug maintenance. Spark plugs approved by the makers for use in Jacobs engines are classified by types of harness and thread sizes. Instructions are given for the proper setting of the gap to meet different conditions of operation and recommendations are made for the complete reconditioning of spark plugs.

Service Bulletin No. 29 deals with the repair of oil-pump pressure sections. The procedure is outlined for salvaging much pressure sections when it is found that the fit between the section and the idler shaft exceeds the loose-fit replacement limit, as specified in the manufacturer's table of limits. *Jacobs Aircraft Engine Company*, Pottstown, Pa.

Bearing Stock List Expanded

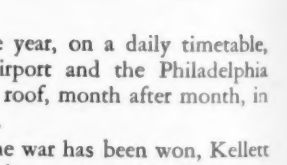
A feature of the new *"Compo" Oil-Retaining Porous Bronze Bearing Stock List No. 2* is the inclusion of many heretofore unpublished sizes and shapes, notably the self-aligning bearing types. Dimensions and prices on a large number of sizes in sleeve-type and flanged bearings, as well as thrust washers and solid plugs, are also tabulated for quick reference.

A variety of essential information on "Compo" material is given, such as chemical and physical properties, tolerances, application data, and detailed installation instructions by standard practice methods without machining. *Bound Brook Oil-Less Bearing Company*, Bound Brook, N.J.

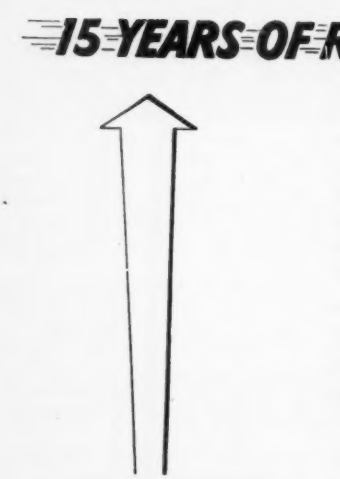
Emergency Training

Drill for Ditching. The training given American Airlines' crews to assure greater transatlantic safety is described. The article explains how crews are trained to abandon ship within 30 sec. from the time of landing in the water. *Flagship News*, December, 1943.

One of an earlier fleet of Kelletts, developed in cooperation with the United States Army Air Forces.



15 YEARS OF ROTARY WING PIONEERING



A Kellett takes off vertically, lands practically anywhere. Air speeds—from practically 0 to 120 MPH.

1944 marks the fifteenth year during which Kellett has been producing rotary wing aircraft. Each year the path of progress in this branch of aeronautical science has been extended by additional Kellett in-the-air accomplishments.

All wartime production of Kellett's advanced types of rotary wing ships is in cooperation with the United States Army Air Forces—details may not be given now.

But among many, even *pre*-war indicators of postwar opportunities to save time and cut costs for industry, commerce and agriculture, is this historic Kellett record: completing 2,607 flights in a single year, on a daily timetable, between airport and the Philadelphia post office roof, month after month, in all seasons.

When the war has been won, Kellett looks ahead to opportunities for its expanding corps of forward-looking engineers to apply their accumulated rotary wing experience to producing aircraft for patrolling electric power lines and oil pipe lines, spraying and dusting crops and orchards, oil and mineral prospecting, forestry fire prevention, transporting mail and passengers directly to urban centers. Kellett Aircraft Corporation, Upper Darby (Philadelphia), Pennsylvania.

KELLETT

OLDEST ROTARY WING AIRCRAFT MANUFACTURING COMPANY

From the Industry

Oversize Rivet Set

An oversize rivet set $2^1/_2$ in. in diameter is said to eliminate the danger of dinging thin skins, even when used by unskilled labor.

Forged from tool steel and heat-treated, the even heat grain flow of this set is claimed to have great impact resistance and a minimum fracture possibility. An ultrasmooth finish on the crown surfaces is designed to protect thin skins from dents and abrasions while riveting. Aero Tool Company, Burbank, Calif.

Heavy-Duty Rectifier

A new rectifier with a d.c. output sufficient to operate heavy-duty aircraft gun turrets provides ground crews with power for servicing and testing airplanes of all sizes. It is stated that the extra heavy inrush current required can be delivered while ample voltage is maintained to prevent drop-out of turret relays, and that the "no-load" voltage is within the safe limit of any delicate electronic service or other electrical equipment in a plane.

The rectifier provides voltage control with a "no-load" limit that may be set and locked to prevent tampering. The rectifying element is of the "self-healing" dry-disc magnesium-copper sulphide type. The bridge circuit is entirely insulated from the primary. Three-phase rectification makes for smooth d.c. output. Airplane Manufacturing and Supply Corporation, North Hollywood, Calif.

Automatic Shut-Off Valve

A new automatic safety shut-off valve or "hydraulic fuse" for airplane hydraulic systems, known as Type HF-40, is designed as a means of preventing loss of hydraulic fluid from ruptured lines or fittings caused by gunfire, fatigue caused by vibration, or other reasons. It can be applied as one unit for each four-way valve or as a single unit for the entire hydraulic system of the airplane.

The former application is entirely automatic and requires no assistance from the pilot, but the latter requires him to isolate the ruptured part of the system by restoring the four-way valve to the neutral position and then to reset the fuse to allow operation of the remainder of the system.

The device weighs 1.8 lbs. and measures $5^3/_4$ by $2^5/_8$ in. The major operating parts consist of a spring-returned displacement piston, a balanced pressure poppet, a balanced return poppet, a bypass valve, and a reset lever and cam. Alco Valve Company, St. Louis.

Flame-Resisting Process for Plywood

Sheets of plywood are flameproofed, a carload at a time, by the Minalith process, a pressure treatment that employs a combination of phosphate, sulphate, and boron chemicals. The new treating process is claimed to prevent flamespread and delamination by filling the wood cells throughout the plies with chemicals that entirely inhibit the flaming characteristics of wood substance.

Procedure followed in flameproofing plywood doors for a West Coast blimp hangar sets a pattern for fire-retardant treatment. The plywood is fabricated and then shipped to wood-preserving plants where it is impregnated under pressure in steel cylinders and thoroughly dried after treatment. Returned to the maker's plant, the plywood sheets are given two coats of paint before erection, followed by a camouflage paint application after they are set in place. Plywood sheets are sanded after treatment if they are to be used in natural grain-finish panels. If sheets are to be used in units, no sanding is required. The treated plywood will take any good grade of paint. American Lumber & Treating Company, Chicago.

Survey of Air Transport

"The Future of Air Transport" is the title of a nine-page survey of the industry, by Roger W. Babson, having particular reference to the stocks of the companies. It compares the position of the companies engaged in manufacturing activities with that of the organizations that operate in the air transport field on the basis of postwar conditions and the reconversion to peacetime business. It stresses the economic advantages held by the air lines, especially from the standpoint of "roadbed" or "maintenance of way" problems encountered by surface transportation enterprises. Financial statistics are given on five of the larger air-line companies. Babson's Reports Incorporated, Babson Park, Mass.

Recognition Light Switch

Recognition light switch, model LS-15, furnishes control over the outside lighting system of an airplane for purposes of identification and recognition. A toggle switch provides separate control over each of four lights—white, red, green, or amber. By varying the pattern of the light according to the three positions possible for each switch—"steady," "off," and "key"—it is possible to work out 81 distinct combinations. This number can be extended to an almost unlimited degree by using different keying patterns.

The toggle switches are of the luminous type. The Army-Navy approved keying switch is capable of controlling circuits of over 140 watts. The user may drill a hole, or holes, in the box for the connecting wires at whatever point is best suited to the installation. Five wires with terminal lugs are required but not supplied by the manufacturer.

Four mounting holes, 0.180 in. in diameter, are provided in the back of the box. Each is centered $1^5/_{32}$ in. from the vertical axis of the box and 1 in. from the horizontal axis. The box and cover are fabricated of drawn aluminum alloy and painted to specification. Overall dimensions are $3^3/_{16}$ by $3^7/_{16}$ by $2^7/_8$ in. The weight is 11.5 oz. Pacific Division of Bendix Aviation Corporation.

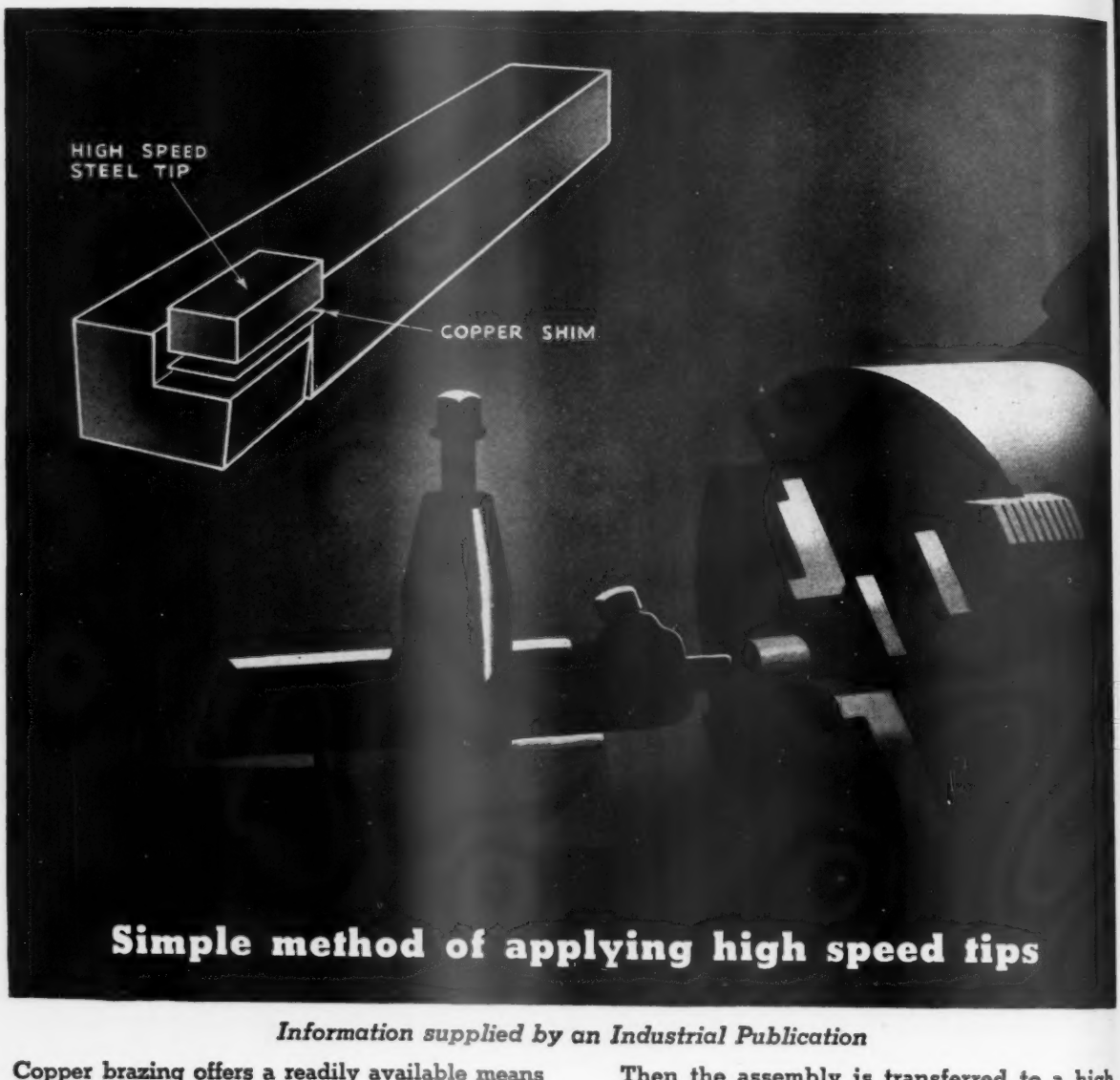
Bendix Pacific Division

Bendix Aviation, Ltd., of North Hollywood, Calif., is now operating as the Pacific Division of Bendix Aviation Corporation. The changeover from the former status of a California corporation will affect only administrative and legal considerations. Operations and personnel will remain unchanged. Bendix Aviation Corporation.

Radio Repair Kit

To make it unnecessary for damaged aircraft radio loops to be kept out of action for indefinite periods by being returned to the factory for repairs, a method of repairing them in the field with the aid of an aircraft radio loop field repair kit has been developed. The kit is composed of a rubber-shaping hammer and mold for straightening loop cases and various other tools for making mechanical adjustments.

In addition to the receipt of a cash award, the worker who developed the kit has been given a job in the Model Laboratory of the Standards Department of the company where he is working on new developments. He is at present devising a small, compact repair kit for aircraft transmitters. Bendix Aviation Corporation.



Simple method of applying high speed tips

Information supplied by an Industrial Publication

Copper brazing offers a readily available means of mounting high speed steel tips on low alloy shanks for cutting tools.

The procedure is quite simple. A recess milled in the shank is thoroughly cleaned and coated with brazing flux. The flux is also applied to the high speed steel tip. A copper shim (0.003 to 0.005 in. thick) is cut to the size of the recess.

The shank is heated until the flux flows freely before the shim is fitted in the recess. After the shim and tip are put in place, the assembly is brought up to 1650° F., in a preheating furnace.

Then the assembly is transferred to a high heat furnace and held at quenching temperature (2200-2350° F.) until the tip is soaked through. Copper melts at 1980° F., therefore the shim will melt and spread over the interfaces, forming a firm bond.

After withdrawal from the furnace the tip is aligned and pressed into place to squeeze out excess copper and flux. As soon as the tip is well bonded to the shank, that end is oil quenched. Final operation consists of the usual high speed steel temper at 1000-1050° F.

CLIMAX FURNISHES AUTHORITATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS.

ARMY E NAVY

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MOLY

Recent Fastening Devices

The recent introduction of a floating "Cam Collar" or receptacle for cowl fasteners is claimed to have permitted spotting tolerances to be increased to over 1/8 in. in any direction without distortion or warpage of the sheets. The complete line of these collars includes several others for rivet-type installation, as well as one that is mounted in a single hole.

The removable stud assembly, which has a permanently installed cross pin, and permits last-minute insertion with panel in place to insure an accurate fit, has been further strengthened by modifications in design. The maker has also added to its line a self-locking anchor nut made in a variety of sizes and models. Camloc Fastener Corporation, New York.

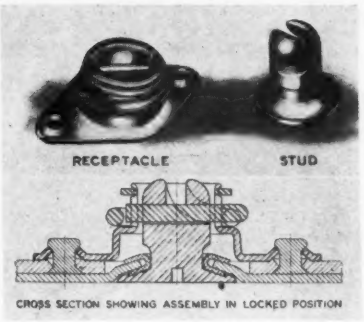
Air-Conditioned Navigation Trainer

The Celestial Navigation Tower Trainer, a plane fuselage large enough to accommodate the entire crew of a bomber, is designed to duplicate flying conditions and problems encountered in the air on actual bombing missions. Bombardier, pilot, radio man, and navigator go through their routine work and perform all the duties of actual low-altitude and precision bombing without leaving the ground. Suspended in a tower on a framework, the training "bomber" can turn, spin, and execute almost any maneuver of which a real plane is capable except looping. A revolving dome overhead simulates the heavens with the stars accurately spotted. For night flying problems, these stars show as pin points of light. It is reported that the twelve navigational stars are placed so exactly that the navigator can take as accurate a reading with his sextant as if he were reading an actual star.

This "sky" is so sensitive that variations of more than 2° or 3° in temperature will give the navigator a false reading, which, of course, would result in missing the exact area of the bombing mission. This is one of the prime reasons for the need for constant temperature, with 72°F. inside temperature selected as the average condition to be maintained the year round.

Inside the bomber are all the actual controls, radio navigational and bombing equipment found on a real bomber. A specially designed Carrier air-conditioning system composed of three package units is installed to protect these instruments from dust and humidity and to insure their proper functioning.

Just beneath the plane an image of the ground is projected on a screen to simulate the terrain passed over. The "ground" moves at exactly the speed at which the plane is flying, while cloud formations are simulated by another projector. At the same time, every move of the crew is automatically recorded in the control room below. There an operator synchronizes the stars overhead, puts in the velocity and direction of wind, and checks any mistakes made by the crew in carrying out their mission. Carrier Corporation, Syracuse, N.Y.



Elastic Stop Nut spring-lock fastener for engine cowlings.

Name Changed

The Corrosion Control Corporation at Norwalk, Conn., has changed its corporate name as of January 1, 1944, to Cordo Chemical Corporation. The firm is now offering industrial coatings, finishes, lacquers, and bonding adhesives. With the exception of Co-Res-Co, a plastic corrosion resistant coating, the products are all being marketed under the trade name "Cordo." Cordo Chemical Corporation.

Kitchen Knife Sharpener Adapted into Metal-Burring Tool

A simple, inexpensive kitchen tool for sharpening knives has been adapted to trim smooth the edges of rough metal stock being shaped into parts for Curtiss P-40 Warhawk fighters and Curtiss C-46 Commando military transport planes. The small knife sharpener with roller discs has been given a special V-shaped metal guard to protect workers' fingers and a plastic handle to lessen fatigue in taking burrs from rough edges of newly cut aluminum parts. The new tool has speeded production by eliminatinga much slower method, clears both edges in a single operation, and leaves an edge without scars.

Workers in the burring department use the tool on strips of aluminum stock after they have been cut by shearing machines into certain lengths and sizes according to template pattern. Before these parts go to hydraulic presses or punch presses, their rough edges must be smoothed to prevent cracking and injury to workers during handling. Curtiss-Wright Corporation.

Suction and Air Pressure System

A new suction and air-pressure system for aircraft consists of an engine-driven air pump, pressure safety valve, oil separator, and a throttling unloading valve. The system provides suction for gyroscopically operated flight instruments and air pressure for the operation of large deicer systems. It is stated the throttling unloading valve maintains constant suction for instrument operation and unloads the air pump when the pressure differential between the pressurized cabin and atmosphere is sufficient to operate the instruments. The engine-driven air pump weighs only 11 lbs., and incorporates a sheer section for protection in event of overload, a removable flexible drive coupling for torsional flexibility, a nitri-cast iron pump liner, and improved through-type interlocking vanes. Eclipse-Pioneer Division, Bendix Aviation Corporation.

Lightweight Spring-Lock Fastener

Rights have been acquired for a spring-lock fastener of new design, particularly suited for holding the engine cowling of high-speed warplanes. It is reported that the Army Air Forces have tested it at Wright Field and have found that it meets specifications for use in any Army airplane. Also it is stated that after complete testing the Navy's Bureau of Aeronautics has found that it meets Navy specifications for aircraft of that branch of the service.

In addition to its uses on airplanes, this fastener is suited to many postwar commercial applications, such as access plates on farm machinery, panels on motor trucks, home heating units, radio equipment, and at any point where a quick-acting, vibration-proof, nonrattling fastening is needed. Elastic Stop Nut Corporation of America, Union, N.J.

Night-Landing Buoy

A buoy for use in night airplane landings at sea is expected to have far-reaching results in the advancement of aviation after the war. The buoy, developed by The Firestone Tire & Rubber Company and the Westinghouse Electric & Manufacturing Company and stated to be very steady and visible more than 3 miles and from a height of 4,000 ft., is now being used by the navies of the Allied Nations to mark landing lanes for seaplanes.

It is expected that this type of rubber buoy will enable postwar passenger and freight planes to land with safety at seadromes that previously permitted only daytime operation, while small inland lakes and rivers may provide safe landing places at all hours. When it is not being used for marking night-landing lanes, the buoy may be used as a daytime marker or a mooring buoy.

The lights on the buoys may be operated manually or by radio. Through the use of a secret frequency the lights may be turned on from the plane by the pilot himself. A claimed advantage is that the Firestone buoy is immune to shock. Wings or pontoons of seaplanes may strike the buoy without damage to either. Although the buoy might be tossing in a rough sea, it looks stationary to the incoming pilot. It flexes under wave action so that the center of buoyancy is altered and the light unit remains practically stationary.

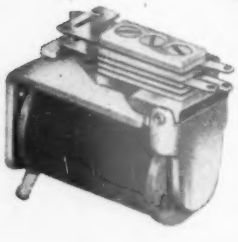
The unit consists of a doughnut-shaped rubber floating device that supports the lighting mechanism. This mechanism consists of a light standard and battery container. The light is

"I needed a relay as short as this ...and long on stamina"

"AND I found it in the Automatic Electric Class "S." This tiny relay is marvellously compact, light in weight and packs plenty of power. But that's only part of the story. For dependability under tough service conditions, I haven't found its equal."

• • • •

The Class "S" Relay was designed especially for dependable use on fast, modern aircraft, where vibration and acceleration are tough obstacles for *any* electrical equipment. Here are some of the reasons why Class "S" does its job so well:



1. Vibration resistance is part of its basic design—built-in, not added on. It surpasses the most rigorous tests required by the Signal Corps and the Air Forces.
2. Its unique spring design provides high contact pressure within small space limits.
3. Twin contacts—independent, self-cleaning—provide maximum contact dependability.
4. Pin-pivoted armature with full length bearing provides long working life under tough service conditions.

To get the full story on Class "S" and other Automatic Electric relays, write for Catalog 4071—the most comprehensive handbook ever published on relays and their application.

Class "S" Relays are available with a wide variety of coil and contact combinations, and operate and release speeds. The single arm relay shown above has a capacity of six contact springs—the double arm, twelve springs.

Relays
AND OTHER CONTROL DEVICES
by AUTOMATIC ELECTRIC

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PARTS AND ASSEMBLIES FOR EVERY ELECTRICAL CONTROL NEED

capable of operating 200 hours continuously without battery replacement and 500 hours when the flashing type is used. The Firestone Tire and Rubber Company.

Electric Arc Welding Developments in 1943

It is stated in a brief review of the 1943 achievements in arc welding that one of the outstanding developments has been the extension and perfection of gas-shielded arc-welding methods. Both argon and helium have been used successfully to provide an inert gas shield around either a tungsten or carbon arc-welding electrode in the welding of magnesium alloys in particular and of some other alloys as well.

The arc welding of magnesium in the repair of castings has been widely extended. Army Air Corps specifications permit the use of inert gas-shielded arc welding for certain repairs on magnesium-alloy castings. Indications are that this process will make an important contribution to conservation and production in this field.

A large amount of developmental and experimental work has been done on the gas-shielded arc welding of wrought magnesium alloys in preparation for the apparently inevitable wide adoption of extrusions and rolled sheet in the metalworking industries. Notable among the results of this developmental work are the so-called "reverse-bevel" joint preparation for butt joints in thin magnesium-alloy sheet, the use of formed backing strips of thin stainless steel for the same type of joint strength and soundness by controlling the amount of drop-through, and the dispersion of the oxide present on the plate edges.

Two marked trends in the a.c. arc-welding field are noted, and comment is made on new equipment and on the efforts to reduce electrode consumption while increasing total output. General Electric Company.

Electrical Developments in Aviation Industry

In a review of the contributions of the electrical industry to the advancement of aeronautics during 1943, brief comments are made under the following heads: Power-Operated Turrets; Automatic Pilot; Turbosuperchargers; Unilever Power Control; Ignition Systems; Electrical Systems; Motors and Operators—(A-c/d-c); Aircraft Controls; Circuit Breakers; Aircraft Instruments; Temp-Turb; Communications; and Plastics. How electric-appliance facilities were converted to making aircraft devices is covered, as well as the engineering work done in connection with aircraft production. General Electric Company.

Ignition Cable for Aircraft

A new high-tension cable, tested in accordance with Army Air Forces specifications for use on aircraft-engine ignition systems, is a synthetic (Neoprene) sheath-type cable. It has high heat, moisture, and oil resistance and is said to withstand the effects of an electrical discharge at low atmospheric pressures.

The conductor of this new cable is flexible. It consists of Monel wires twisted together and covered with an insulation of low-capacitance rubber compound reinforced by a braid of glass yarn for added tensile strength and ruggedness. The outer sheath is Neoprene, marked in conformance with A.A.F. specifications to show the name of the manufacturer, cable size, and date of manufacture. An overall thin coating of transparent wax aids in handling and installation. General Electric Company.

Automatic Drill-Press Control

Powered by air, the Hydra-Drill is designed automatically to operate a drill press so that the customary hand feed, while it can be used if necessary for individual operations, is unnecessary for fast production. It permits the operator to devote full time and attention to feeding the work to the drill press. Adjustable stops permit accurate adjustment for all drill-press operations such as drilling, counterboring, spot facing, blind drilling, reaming, and other operations on any type of materials or parts.

The range of feed can be regulated for fast drilling of soft materials or slow drilling of hard materials. For piece work, the device may be used to set the rate of feed for drilling a given number of pieces per hour. A safety feature consisting of a finger-tip control permits immediate release of the automatic feed. Under some production conditions it may be applied to two drill presses to permit one operator to operate both of them.

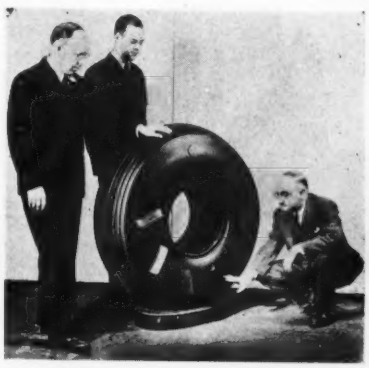
One feature is that the rate of feed of the drill-press spindle can be adjusted so that the pressure of the drill on the work is right for any particular drilling operation, regardless of the size of the drill which is used and the rate of speed at which the drill is operated. This adjustable feature is intended to save breakage of small drills which are broken when too much pressure is applied to the hand feed by the operator. The General Pacific Corporation, Los Angeles.

"Self-Starting" Airplane Tire

A "self-starting" airplane tire that will obtain high rolling speed before it touches the ground—easing the wear and tear of landing impact—is described. The prelanding rotation requires no motor, being achieved simply by an arrangement of vanes or fins built into the sidewall of the tire so that when the landing gear is lowered they catch the air and set the wheel spinning. The fins, made of rubber and fabric, are so constructed and placed that they spring back into position flush with the tire's side on the "upper half" of each rotation of the wheel.

The effectiveness of this mode of starting the rotation in lessening airplane tire wear has been demonstrated in tests, according to the maker. It is reported that special tires of the 17.00 by 16 size furnished to a commercial air line had successfully made more than twice as many landings as the average number of landings made by conventional tires of the same size in similar service.

Although reduction in landing-impact wear was the primary reason for the invention, it is stated that the spinning wheels make possible noticeably smoother landings, even smoother than have ever been achieved by the use of extremely low inflation pressure. Landing-shock wear has been an increasingly critical problem to the aviation and tire industries in recent years because of the increase in plane size and weight and the higher landing speeds, demanding larger tires. Prerotation is also expected to contribute to lessening the strain put upon landing-gear assemblies.



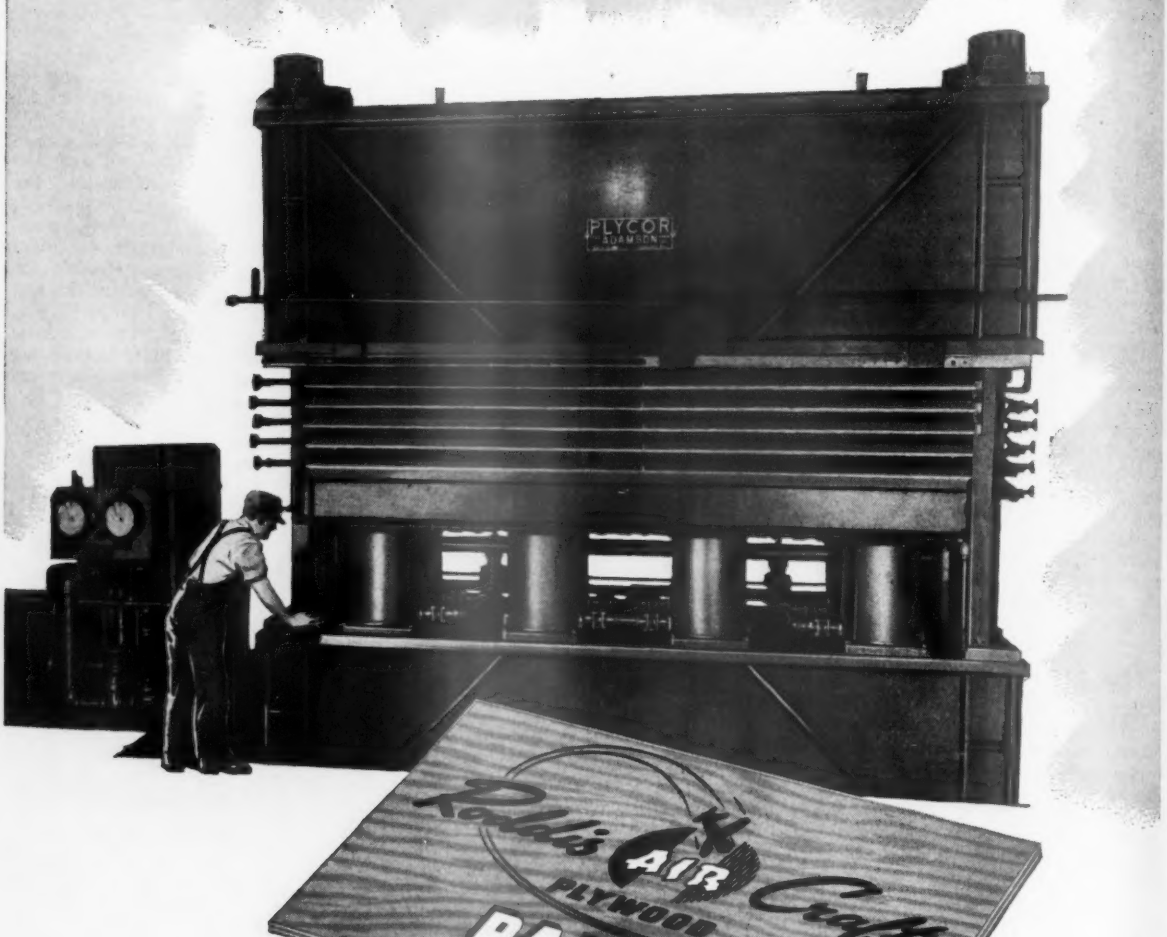
Fins built into the sidewall of this Goodrich tire catch the wind when the landing gear is lowered and start the tire spinning before it touches the ground, thus greatly lessening the wear and tear of landings. The fins are constructed in such a way that they spring back flush with the tire's side on the "upper half" of each rotation of the wheel.

The new vaned tire makes it possible to have the landing wheels spinning at approximately the plane's ground speed when the plane first contacts the ground, whereas without prerotation there is not only much greater initial shock but a considerable amount of "drag" along the ground before the wheels can attain sufficient speed to be rolling at the same speed as the plane is moving.

The chief distinguishing feature of this contribution to the science of plane tire prerotation is the achievement of an arragement that allows the vanes to be blown open to full "windmill effect" when the air stream strikes them but then to flatten out quickly for the upper half of the revolution. The B. F. Goodrich Company.

Arc-Welded Hydraulic Airplane Landing-Gear Mock-Up

Students at the New England Aircraft School, Boston, under the supervision of their instructor, have constructed a hydraulic landing-gear mock-



NOW BETTER TOO BECAUSE THEY ARE *Bigger*

Add to the experience and craftsmanship which has made Roddis Aircraft Plywood, outstanding in the field — new mechanical equipment which produces panels 5 x 16 feet — the largest available to the aircraft industry. Pictured above is the largest hot plate press in existence, now operating at Roddis, Marshfield plant on a 24-hour schedule.

The larger the plywood panel the better, because size speeds production at the assembly line. Joining is reduced, less skilled manpower is required and greater strength is inherent with one continuous panel.

For information on shipping schedules of the new Roddis super-sized aircraft plywood panels, contact your local Roddis representative or Roddis men at the warehouse locations shown.

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RODDIS PANEL AND DOOR COMPANY
1204 W. Ormsby Ave., Louisville, Ky.

up used in training the student airmen to operate the landing gear, bomb doors, wing flaps, and brakes and to make various inspections. The fixture houses the landing wheel, hydraulic pumps, controls, tanks, pressure-relief valves, and lines that are used on one of the bombers flown by the Army.

As it was impossible for the Army to send to the school a complete airplane of this type for instruction, it became necessary to construct this mock-up, and, as classes were to start almost immediately in this kind of instruction, the school had just 28 days to complete the unit. The specified chrome-molybdenum aircraft tubing would have been too expensive and would have required three months for delivery, but the school had previously obtained 2,000 ft. of old boiler pipe and had used it to fabricate many units such as propeller dollies, engine-change work stands, stepladders, barrel dollies, and airplane-fuselage tail stands. The students prepared the shop drawings, used the second-hand boiler pipe, and constructed the mock-up by arc welding. Grinding and fitting of tubular joints were eliminated and much time was saved. The main joints were reinforced with $^1/_4$-in. boiler plate gussets.

The estimated time required for the construction of a mock-up to Army specifications was 12 weeks but the school's job was completed in 3 weeks, at a cost of less than half the estimate. This hydraulic mock-up unit has been in operation since the day it was completed. The Hobert Brothers Company, Troy, O.

Cemented Carbide File

The maker has developed a new type of file made of the same hard, high-strength cemented carbide compositions as the steel-cutting Kennametal lathe and boring tools. It is designed to meet the higher speeds of modern lathes necessary for the performance of work with carbide-tipped cutting tools and to have the ability to file revolving work pieces without reducing speed.

It is stated that the file will cut steels of a hardness up to 62 Rockwell C and does a noteworthy job on cast iron and brass at surface speeds around 900 ft. per min. High-carbon, high-chromium steels have been filed at 800 surface ft. per min., with the files still in good condition after three weeks of use.

At the present time, these files are available in one size, called the F76. It is 11 in. long, $^3/_4$ in. wide, and $^3/_8$ in. thick, having a filing surface 4 in. long, made of grade K4H Kennametal (80.6 Rockwell C), single cut with teeth at 30° shear angle, 40 per in. Kennametal Inc., Latrobe, Pa.

Merger of Glider Builders

It was recently announced that negotiation between the Laister-Kauffmann Aircraft Corporation of St. Louis and the Bowlus Sailplanes Company, Inc., of Los Angeles had been completed and approved by the boards of directors of both corporations for the Laister-Kauffman company to acquire the Bowlus company through an exchange of stock. Stockholders of Bowlus Sailplanes Company, Inc., will receive, under the plan, stock in Laister-Kauffmann Aircraft Corporation and profit-sharing certificates. They will also receive options to purchase additional Laister-Kauffmann shares.

Releases are printed as received from companies and other aeronautical organizations and the responsibility for the accuracy of all statements is therefore not assumed by the Aeronautical Engineering Review.

Under the projected arrangement the new company will have facilities for the manufacture of troop-carrying, trainer, and transport gliders. It will also increase the number of Laister-Kauffmann glider designs, in addition to the two-place trainer design and the 30-piece cargo glider, as well as a single-place, eight-place, and fifteen-place types. Laister-Kauffmann Aircraft Corporation, St. Louis.

Change of Corporate Title

Lawrance Engineering and Research Corporation, engaged in building auxiliary power plants, cabin-supercharging equipment, aircraft instruments and equipment and in engineering and research development, with plants at Linden and Elizabeth, N.J., has changed its corporate title to Lawrance Aeronautical Corporation.

Chart of Aeronautical Material Specifications

A chart of aeronautical material specifications for ferrous and nonferrous metals takes the form of three concentric discs. One side of the middle disc has its periphery divided into segments representing different metals, each class being printed in a distinguishing color. Inner circles carry the corresponding Army-Navy, Army and Federal, and Navy specification numbers. The outer disc contains slots registering with the printed specifications on the inner disc in such a manner that, by rotating the inner disc to the selected material, the corresponding specification numbers can be read through the slots or "windows." The reverse side of the chart gives the physical properties and chemical analyses of the materials, readable through slots in a similar manner. The chart was prepared by S. H. Phillips, author of *Aircraft Processes*. Warren F. Lewis, Los Angeles.

Flexible Rubber at −85°F.

Low-temperature extrusions, moldings, sheets, and gaskets are intended for use in aircraft manufacture where cold-test stock must meet aircraft requirements of −65°F. Developed through the "Controlled Rubber" process—the identification for rubber manufactured to the industrial user's specifications—the maker's neoprene base, E-3, has a minimum tensile strength of 1,500 lbs. per sq.in. and elongation of 300 per cent. Laboratory tests are reported to show it to retain flexibility to the low temperature of −85°F. or 15° colder than present aircraft specifications.

For aircraft fuel containers, N-1 fuel cell fittings, moldings, and gaskets have a minimum tensile strength of 1,500 lbs. per sq.in. and elongation of 225 per cent, with low-swelling properties in power-plant oil and fuel oil. N-1 is formulated to give maximum resistance to aromatic fuel to meet aircraft requirements of −65°F. Los Angeles Standard Rubber, Inc., Los Angeles.

Improved Cold-Weather Starting

A series of basic improvements on the method of diluting lubricating oil with gasoline, in order to facilitate quick starting of aircraft engines in cold weather, is intended to overcome the difficulties of older methods under which the diluent, being introduced before the oil enters the engine, is partially evaporated by the engine heat. The result of the old method is that completely thinned oil is left only in that part of the line between the point where the diluent is introduced and the engine itself. The new method introduces the diluent into the oil after the oil has passed through the engine. This prevents the engine heat from distilling the volatile diluent and thus leaves the lines, engine, and warm-up chamber full of thinned oil. Second, it sets up a by-pass that keeps cold and hard oil from getting into the air cooler and bursting it. In the third place, the new method permits the use of dual return lines to the oil reservoir—one loading into the warm-up chamber and the other into the reservoir. A thermostat located at the point where the diluent enters the oil determines whether the oil shall by-pass the cooler or whether it shall return to the warm-up compartment or to the reservoir. The Glenn L. Martin Company.

Industrial Accident Statistics

Accident Rates in the Aeronautics Industries is a compilation of statistics on industrial accidents and injuries in the aircraft manufacturing and air transportation industries for the year 1942. The aircraft manufacturing figures give comparisons with such industries as machinery, automobiles, sheet metal, and metal products and with the average of all reporting industries. They show frequency rates and severity rates well below the average, but the figures for 1942 compared with 1941 reflect an upward trend in all categories of injuries to personnel except in the severity of temporary total disabilities, where the rate was 37 per cent lower. Injury rates of individual industry units are

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tabulated according to the type and size of the company, covering aircraft manufacture and assembly, manufacture of engines and engine parts, and manufacture of parts and accessories, with an average for the entire industry. Another tabulation shows an analysis of the cause of injuries.

Accident rates in the air transport industry are reported in a similar manner. The frequency rate was 13 per cent lower than the average, making the best showing in comparison with the rates of other industries, but the severity rate was slightly higher than average. Figures are broken down according to the different occupations and causes of accidents, and rates are analyzed by occupational groups. Highlights of 1942 experience are summarized for each of the two sections of the report. National Safety Council, Inc.

Milling Machine for Beveling Flat Aluminum-Alloy Sheet Stock

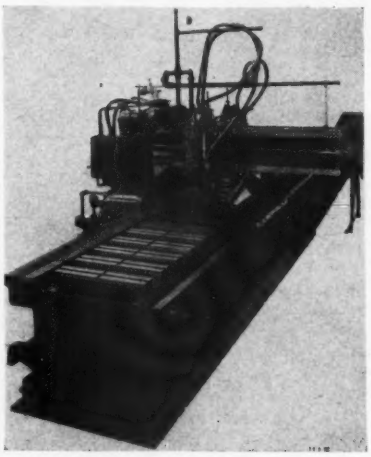
The purpose of a new type of high-speed nonferrous machine is to mill a long, flat bevel on aircraft wing and fuselage sheet stock so that skin sheet sections may be lapped to form a smooth surface. Bevels with surface widths up to 8 in. may be machined. The builders state that surfaces are milled to a mirror finish in a single pass and have been checked and found true-flat to 0.0001 in.

Basically, this machine consists of a long bed and T-slot table on which work is held. A carriage travels over the bed to move the cutter head along the work. The bridge arm of the carriage holds two cutter heads, each of which may be tilted up to 15° off perpendicular, in a vertical plane parallel to a vertical plane running lengthwise with the bridge arm. Bevels may be milled on work in two different types of operations, and the nature of the work, of course, determines which type is employed.

For a constant or straight-line bevel, work is set up on the table so that the bevel milled will be parallel to the direction the carriage travels—in other words, parallel to the length of the bed. The bridge arm is positioned to form a 90° angle with the length of the bed and direction of carriage travel.

Cutter heads are set at the angle required to make the bevel. Both cutter heads may be used in one pass if necessary. End-mill type or fly cutters may be used for recommended maximum working diamter of 8 in. Cutters are directly driven at 3,500 r.p.m. by 15-hp. motors. In this type of setup the carriage is driven over the bed and the bevel is milled so the carriage travels over the work.

For a bevel on a taper or crosswise edge, the work is milled by moving the cutter head in a vertical or untilted position across the bridge arm screw. Work is held in a fixture in a tilted plane to the angle of the bevel required. Bevels of this type can be only as long as motor travel across the bridge arm permits . . . . 30 in. travel being the maximum for a 90° crosswise edge, and



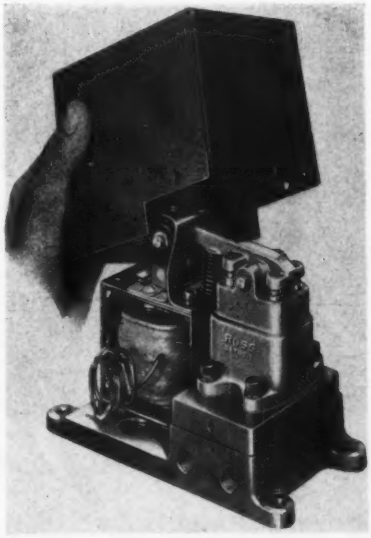
The Onsrud high-speed nonferrous milling machine.

less for the taper edge, depending on the angle of the taper.

One of the most important features of the A-96 bevel mill is a centrifugal bearing preloader which is responsible for the 0.0001-in. machining accuracy claimed for the vertical motor-driven end-mill cutters. A specially designed vacuum chuck is employed to hold work during milling operations. Onsrud Machine Works, Inc., Chicago.

Three-Dimensional Pictures

Polaroid three-dimensional pictures, known as vectographs, are being used in training classes in military navigation. They are prepared as slides for projection by standard projectors on a classroom screen. Students feel they are looking at precise wire models of the heavens, with relative positions of the stars and the earth immediately apparent.



This compact solenoid air-control valve can operate at sustained speeds as high as 400 reversals per min. (*See* page 197.)

A three-dimensional vectograph is a specially treated plastic sheet. On it, two pictures occupy the same space at at the same time. Polarizing three-dimensional viewers separate the superimposed pictures to recreate the normal condition of effortless three-dimensional vision. Polaroid Corporation, Cambridge, Mass.

Air Express Records in 1943

Air express handled by the nation's commercial air lines set new records for number of shipments, weight, and gross revenue in 1943, according to an annual survey. The bulk of air-express cargo handled by the air lines and the express agency during the year comprised shipments of essential war materials moving under priority, while commerical or nonpriority traffic was carried on a space-available basis.

Preliminary figures indicate approximately 14,000 tons of air-express cargo were flown over the 18 domestic air lines during the year, compared with 10,850 tons in 1942. An average of 45 tons daily were flown over the 45,000-mile domestic air-line network. Of the 5,000 air shipments flown per day, the average shipment weighed almost 20 lbs. and was flown 1,000 miles. Approximately 1,500,000 shipments were carried in air service during the 12 months.

The year was marked by the inauguration of several exclusive mail and express flights. Three such flights now are operating coast to coast, the fourth between New York and Miami. One of these trips operates with DC-3 planes completely converted to cargo equipment and has a capacity of 6,000 lbs. of mail and express. The remainder of the air express was carried in the combination passenger, mail, and express planes.

Even though complying with wartime restrictions, international air-express service, connecting with the domestic air routes at Miami, Brownsville, Los Angeles, Fort Worth, El Paso, New York, and New Orleans, averaged 14,000 shipments a month during the year. New Orleans was added to the international airport list in July, and the second anniversary of transatlantic air express was observed in December.

A rate reduction ranging up to $12\frac{1}{2}$ per cent became effective on July 15 and was considered to be indicative of how increasing air-cargo volume will result in savings to the shipper. Railway Express Agency.

Decimal Equivalent Chart Calendars

Two sizes of Decimal Equivalent Chart Calendars, one 7 by 15 in. and the other 13 by 27 in., are available for free distribution to engineering and manufacturing concerns having need for information of this kind in convenient form. The chart gives the decimal equivalents, up to six places, of fractions ranging from $\frac{1}{64}$ to $\frac{63}{64}$ and a calendar for 1944. Dayton Rogers Manufacturing Company, Minneapolis.

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Midget Air-Control Valve

A compact solenoid air-control valve, which can be operated at sustained speeds as high as 400 reversals per minute, is known as Ross model No. 835. The newly designed valve is a 1/4-in. heavy-duty, solenoid-operated, four-way valve for the control of double-acting cylinders; it may also be used as a three-way valve by plugging one outlet. This valve is based on the same poppet-type principle that the maker has been building for the past 20 years.

Overall dimensions of model No. 835 are length 7 in., width 3 1/2 in., height 5 1/4 in. Other features claimed are low current consumption, noiseless operation, and long life. Ross Operating Valve Company, Detroit.

Remote Control Circuit Breakers

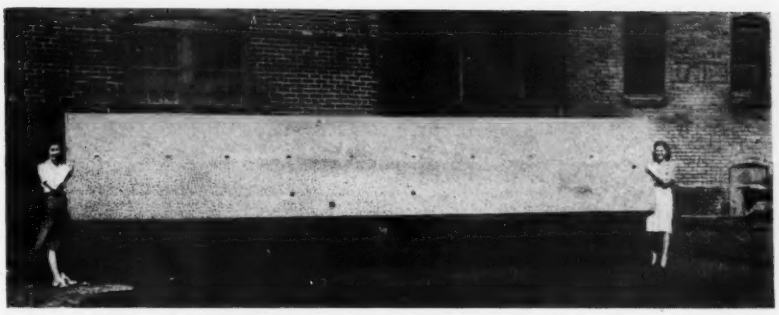
Three new remote-control circuit breakers for aircraft applications have been especially designed for the operation and control of any remote electrical load. These breaker relays indicate circuit operation and can be reset from a control panel. They are calibrated to precision tolerances and made for trip-free or nontrip-free operation. In the trip-free arrangement, the circuit breaker is free to open irrespective of the maintenance of the handle in the closed position. In the nontrip-free arrangement, the operator can override the action of the circuit-breaker relay from the control panel. Spencer Thermostat Company, Attleboro, Mass.

Lightweight Floor Panel

For an aircraft floor panel to withstand an ultimate load of 800 lbs. per sq.ft., a construction called Hollo-Tech consists of a top surface of Ply-Tech, a bottom surface of Ply-Tech, and a core of spruce wood made up of narrow grid strips. Either or both surfaces, top and bottom, can be faced with vulcanized fiber for wearing surface and for its dielectric value. These are machined and laid up in a cubicle design with necessary rails and stiles to frame. The top surface and the bottom surface are then glued with plastic glue to the core to complete the assembly.

The result is a flush co-planer floor less than 3/4 in. thick, with a weight of approximately 0.85 lb. per sq.ft., that would support an ultimate load of 800 lbs. per sq.ft. on 18-in. spans. Specifications require a minimum of deflection and there must be no permanent set at 60 per cent of ultimate load. The core of the floor, being hollow, must have provisions for necessary bolt holes. Where these occur a small block of wood is dropped into the cubicle of the core before pressing, thereby giving a solid construction where necessary. Also, at points of concentrated loads, further reinforcements may be placed at the core.

The top surface must also stand what is called a heel test, made with a block 1 by 1 in. square, loaded up to 500 lbs., in the center area of a cubicle and not supported by any grids.



A Hollow-Tech aircraft floor panel weighs approximately 0.85 lb. per sq.ft., is less than 3/4 in. thick, and is designed to support an ultimate load of 800 lbs. per sq.ft. on 18-in. spans. Floor panels are being made up to 25 ft. long and 4 ft. wide.

Hollo-Tech offers its best strength factors when made in large panels. Floor panels up to 25 ft. long and 4 ft. wide are being made. The continuous length over a large number of supports is designed to lessen the possibility of deflection due to unequal loading of spans. Technical Ply-Woods, Chicago.

Scale for Weld-Bend Tests

A pad of paper scales, called the "Tempilscale," has been designed to facilitate and record weld-bend tests. By using the scale according to directions furnished with each pad, measurements can be made for elongation in stress-reduced and nonstress-relieved joints, and tests can be standardized and simplified. Printed on rag-content paper, the scale offers a practical substitute for the flexible steel rule and is said to be easier to use because it can be more readily applied to sharply curved surfaces. The face of each sheet provides for a permanent record of the test data, while the back carries a table of figures giving the required elongation to cover practically every case.

Corporations interested in weld-bend testing can obtain pads of these scales without charge from the makers, who are manufacturers of thermometric products for the determination of temperature in industry. Tempil Corporation, New York.

Carbon Removal

Plastic pellets are being produced for use in sand-blasting equipment to remove the carbon from the piston walls and piston-ring grooves of aircraft engines. It is stated that the Army Air Forces are now using plastic pellets for this purpose and that commercial air lines are installing equipment to service their aircraft engines in this manner. Tennessee Eastman Corporation, Kingsport, Tenn.

Change of Company Name

The Titeflex Metal Hose Company, which since 1914 has specialized in the manufacture of flexible metallic tubing for the conveyance of fluids and gases for general industrial and automotive application, has changed its name to Titeflex, Inc. The company recently has become a large producer of radio and ignition shielding for aircraft and automotive engines. Titeflex, Inc., Newark, N.J.

Survey of Transportation

The Transportation Problem is a 32-page brochure containing a summary of 8 years of research into the economic aspects of the transportation problem.

It reviews the physical, financial, and traffic aspects; outlines general policies and the position of the different interests concerned; gives a forecast of the future; and presents conclusions and recommendations. It urges that the Congress undertake a complete reappraisal of national transportation policy before consideration is given to major legislation dealing with any one segment of the domestic common-carrier industry.

With reference to air transport, the report notes the great technologic progress made, gives credit for Government aid extended over a period of 23 years, and directs attention to the questions involved in maintaining the economic usefulness of the industry. Transportation Association of America.

Removal of Marking Paper

A chemical compound has been formulated for removing the tightly glued masking paper that covers the sheets and formed parts delivered to aircraft manufacturers. If this glued paper is allowed to remain on the plastic for any length of time—or if it is exposed to heat or sunlight—the paper vulcanizes to the plastic glass and virtually becomes a part of it. It is stated that naphtha solvents, when used for this purpose, often cause "crazing."

With the new product the plastic sheets and formed parts are simply soaked in a tank full of the compound until the gummed paper is loosened so it can be peeled off. Turco Products, Inc., Los Angeles.

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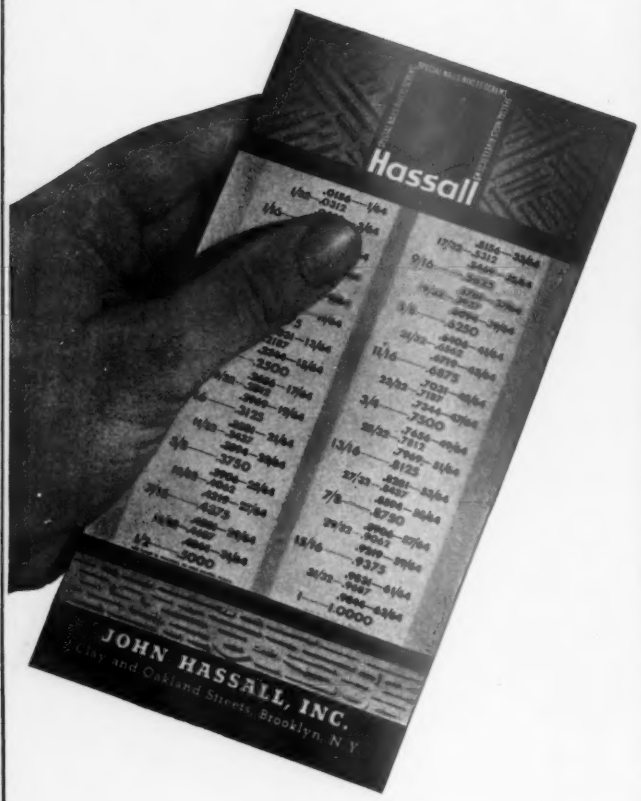

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Wall Chart on AN Standard Conduit Fittings

A wall chart on AN Standard Conduit Fittings is offered for free distribution to the aircraft and allied industries. It is 12 by 18 in. in size and shows at a glance the range of fittings with their dimensions and part numbers, simplifying and saving time in the selection and identification of such fittings. The chart is intended for the engineering, purchasing, electrical, assembly, inspection, and salvage departments of aircraft manufacturers. Union Aircraft Products Corporation, New York.

Exhibition of War Products

Exhibitions have been held in Washington and New York to demonstrate the extent of the development of substitutes for natural rubber, their uses in war materials, and the participation of the manufacturer in the production of equipment for the armed services.

Starting with a model showing the essential parts of a plant for making synthetic rubber, the process is explained for combining chemical elements to make a substance having many of the properties of natural crude rubber, some of which are superior to the natural product for numerous uses. Demonstrations are given of the methods of fabricating the synthetic material into tires, mechanical rubber goods, footwear, clothing, insulation, and a great variety of other products for the war effort and later peacetime applications.

An important part of the exhibition covers chemical and metal products that have been developed, in addition to the manufacturer's principal business in rubber goods. These include munitions, machine-tool products, and a method of electroforming that originated as a part of the process of making tire molds and is now used in calibrating range finders, precision instruments, etc. Facilities of the manufacturer have been applied to the production of aircraft parts, treads and bogie wheels for tanks, gun subassemblies, and many other metal devices, as well as textiles, hospital supplies, hose, bullet-sealing tanks, deicing equipment, and a long list of others, including a complete low-altitude convoy balloon, all of which were shown at the exhibit. United States Rubber Company.

Film Shows Building of British Bomber

A motion picture record of how the workers at a certain aircraft factory in the northwest of England assembled a Wellington bomber in 24 hours and 48 min. on a recent week-end is given in *Wings in Record Time*, a British Ministry of Information film released as a Universal Featurette, to be shown in theaters throughout this country. The workers did this job on their own time, bettering the mark of 30 hours they

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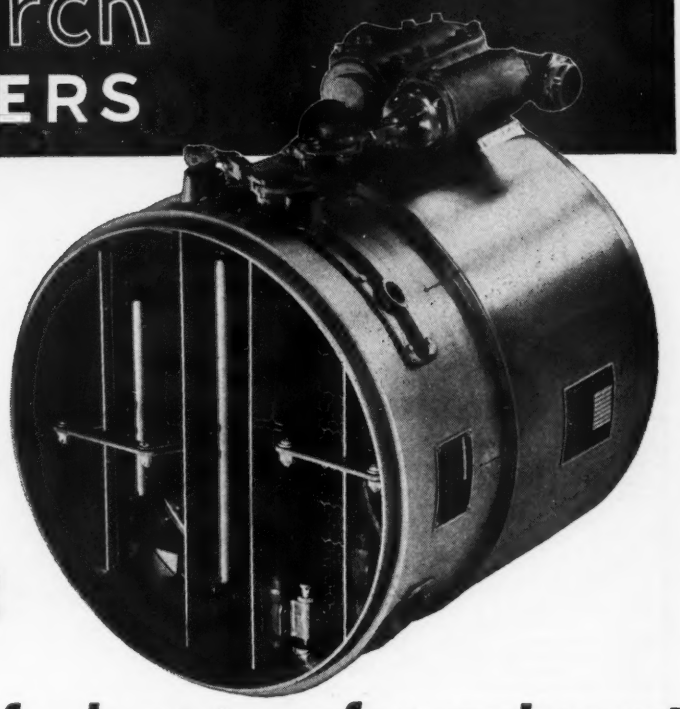
SHELLS OF BRASS,

TUBES OF COPPER



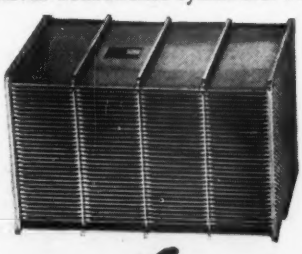
the favorite metals for heat transfer equipment

Air cooling hot motor oil to near-normal temperatures, while automatically regulating the cooling rate in whatever climate the ship must fly, is the job being done—and done well—by AiResearch's Oil Coolers. Built for all types of planes, these precision units require over 1500 individual parts—each produced of the finest material available and held to unusually close tolerances.

Copper and Brass, long known in every branch of industry for their workability, corrosion resistance and high thermal conductivity, are used extensively in these units. Washers, nuts and similar fittings are made of brass rods. Baffles, and inner and outer shells are made of sheet brass, formed and silver-brazed into cylinders. The honeycombed cores, through which the oil flows and over which the cooling air passes, are made up of 1200-odd hex-ended copper tubes, sweated to the shell and tested at 100 lb. air pressure under water at a temperature of 180°.

AiResearch's Supercharger Intercooler

Here again The American Brass Company is privileged to serve—this time through the small tube manufacturing facilities of its French Small Tube Branch—by supplying millions of aluminum alloy tubes. These tubes, partially flattened, are mechanically joined to head plates, making up the core of AiResearch's Lightweight Supercharger Intercooler which makes possible sea-level engine performance at extremely high altitudes. 43168



Well known is the fact that high altitude flying requires the use of a supercharger to compress the rarified air for efficient engine performance. Not so well known is the fact that the temperature of this compressed air is increased considerably, its density is lessened and, if fed to the carburetor without cooling, might result in engine "knock," pre-ignition, overheating and generally rough operation—hence the need for "intercoolers."

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Anaconda Copper & Brass

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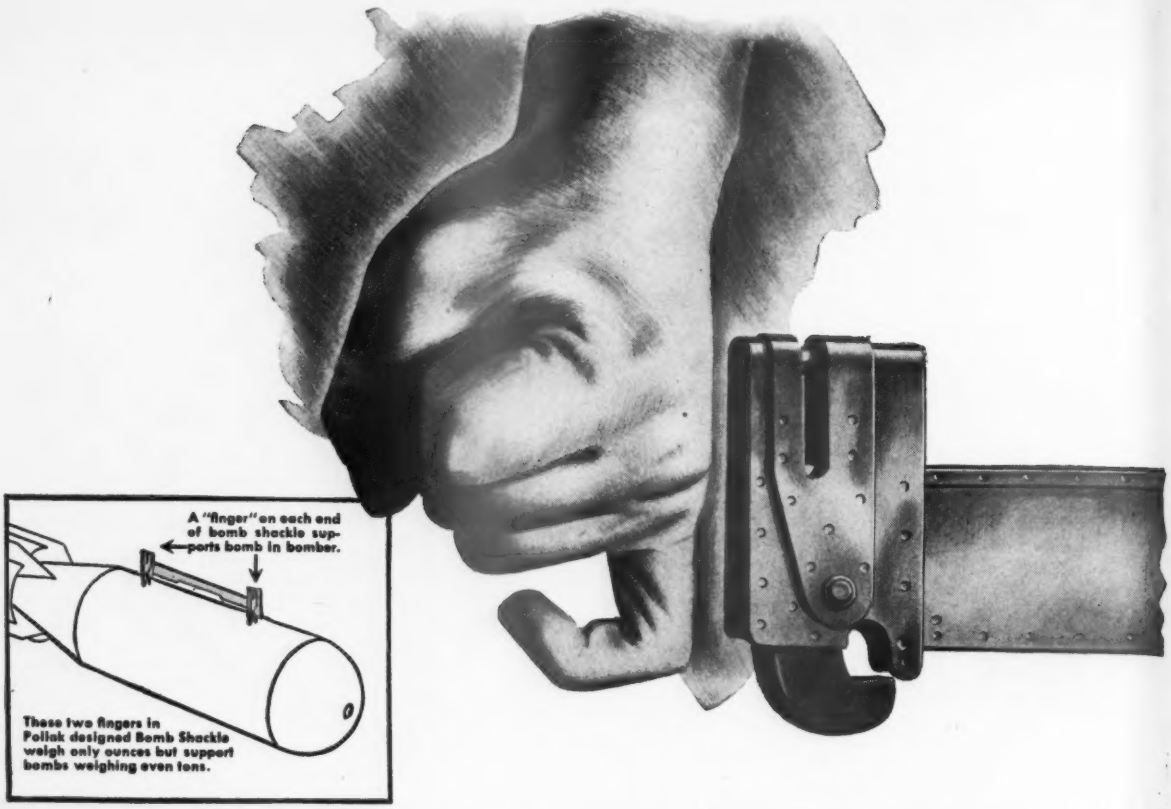
A "finger" on each end of bomb shackle supports bomb in bomber.
These two fingers in Pollak designed Bomb Shackle weigh only ounces but support bombs weighing even tons.

EVER SEE THE LITTLE FINGER THAT HOLDS A BOMB?

THERE ARE TWO OF THEM. One on each end of the bomb shackle that supports the bomb in the bomber. These fingers, weighing only a few ounces, carry the weight of bombs weighing many hundreds of pounds. In split second timing with the bomb sight, in all kinds of weather and temperatures, they must release the bomb automatically—precisely—instantly.

Pollak was given contracts by the Army and the Navy to manufacture these all-important bomb shackles, bomb racks, smoke screen generators, fuzes and other precision devices. In record time we organized a large, modern equipped plant to produce and deliver this war materiel. How well we are doing this job is indicated by the Navy having awarded the Pollak Manufacturing Company the Army-Navy "E" and four stars.

This award indicates Pollak's ability and capacity to produce precision products in large quantities and deliver them on time.

Some day, when peace is won and our own war work is finished, this proven ability of Pollak to engineer, develop and manufacture products that are designed and made right—produced in volume and delivered on time—may be of great value to your business.

Now, while you are planning for peacetime products, we suggest that you plan with us. We will be glad to meet with you at your convenience.

POLLAK PRECISION PRODUCTS

Five Army-Navy "E" awards—the Flag and Four Stars—each of which symbolizes six months of Exacting Service to our Armed Forces, have been awarded to Pollak.

POLLAK MANUFACTURING COMPANY · ARLINGTON, NEW JERSEY

DEVELOPING · DESIGNING · FABRICATING · STAMPING · SPINNING · WELDING · FINISHING · MACHINE WORK

aimed at when the project began on a Saturday morning at nine o'clock.

The picture begins at that point and shows riveters, mostly women, starting work on two sections of the fuselage. The parts are assembled in jigs, the wooden floor is laid, and the forward bulkhead frame goes in with the pilot's seat, control column, and the cockpit floor all in one unit. By 1:45 p.m., the main fuselage is ready to come out of its jig. Meanwhile in the stitching section, the four sections of the 80-ft. wings are being covered with fabric. Nine coats of weatherproofing are next applied by women, while other women control cranes and swing the engines down to their nacelles in the body of the plane. The tail fin is connected and the bullet-proof gasoline tanks are set in. Then the crane picks up the wings and sweeps them into position.

The picture shows a former coach painter as he applies the R.A.F. roundel to the now completed fuselage. Next come workers who attach the port airscrew. Another group fits the starboard propeller. At this point the film has covered 13 hours of the building of the workers' own bomber.

Next the landing wheels are installed. Inspectors check each detail on progress charts and the bomber has begun to look like an airplane. It is ready to be towed to the running shed where the engines, electrical equipment, air frame, and other parts have received the final check. The bomber is ready to fly.

The picture ends as the test pilot taxis the plane down the field and takes off, just 24 hours and 48 min. after the work started. Universal Pictures Company, Inc.

Lightweight 400-Cycle Aircraft Transformer

A 35-kva. aircraft transformer is only about 5 in. wide and weighs but 25 lbs., compared with an ordinary single-phase, 37½-kva. transformer, which weighs 680 lbs. Having a rating of 250/30 volts, the transformer is a member of a new line of 400-cycle electrical devices that were brought into being for a.c. systems on aircraft. This transformer uses class B insulation, is air-cooled, and could be lighter in weight, except for the fact that a compromise is desirable between losses and weight.

Another group of 400-cycle transformers displays even greater weight savings. A 7½ kva., three-phase, 208–190/21–26.5-volt transformer weights but 9½ lbs. It is forced air-cooled and has a regulating winding by which the secondary voltage is maintained constant over a 30 per cent range. By added control equipment, constant d.c. voltage can be maintained, compensating for voltage drop in the rectifier, transformer, and supply circuit. Cores are made of new thin-gauge Hipersil steel, which provides low losses and lighter weight at this higher frequency.

The three-phase core is wound in a novel manner. Two small cores are wound first; then a third core is wound around these first two, giving the necessary core-type transformer having two windows and three legs for the three-phase windings.

A group of 400-cycle, self-cooled autotransformers is correspondingly small. A 5-kva., 120/30 volt unit weighs 8 lbs., while a 1-kva. version weighs 2½ lbs. Both are capable of operation at 200°C. temperature rise. Another 1,500-watt, 180/110-volt autotransformer (with air blast) weighs slightly less than a pound. Thin-gauge Hipersil makes a major contribution to the light weight of all these aircraft designs. Westinghouse Electric & Manufacturing Company.

Test Chamber Duplicates Flying Conditions

A large high-altitude chamber has been created primarily for testing motors, generators, and their controls, intended to reproduce conditions at 70,000 ft. Temperature can be lowered to −67°F. and pressure to ¾ lb. per sq.in., which is about one-twentieth of sea-level pressure. Means are provided for controlling the humidity.

Identical stratosphere conditions are difficult to achieve because all air forced into the chamber under controlled temperature, pressure, and humidity is fresh air. None of the air can be recirculated, otherwise brush dust and gases from the insulation would accumulate to falsify the test results. A mixture of crushed dry ice and varsol is used as the refrigerant.

Incoming air can also be heated and saturated with water, simulating jungle conditions. In this way a complete flight cycle is duplicated, both as to atmosphere and time. Effects encountered in taking off from a hot landing strip in a jungle and climbing (at normal rate) to the cold, dry, rarefied air of the stratosphere can be reproduced. In fact, the chamber makes the conditions somewhat more severe than in actual service.

Brush wear, creepage distances required for different voltages, and ventilation needs of aircraft electrical apparatus are among the problems being studied in the chamber. Westinghouse Electric & Manufacturing Company.

Redesigned Runway Marker Lights

Contact or runway marker lights must withstand being run over by the wheels of a fast-landing plane. Little more than a year ago Westinghouse engineers created contact lights that would not crush under a pressure of 100,000 lbs. compared with the earlier limit of 16,000 lbs. Now, the combination of heavier planes and caterpillar-tread landing gear results in a blow that can crush the 100,000-lb. units. To meet this condition, a new unit has been

New airport runway light unit that will withstand loads of 150,000 to 200,000 lbs. Westinghouse engineers had to redesign the year-old marker because of the introduction of heavier planes with caterpillar treads.

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THE OHIO RUBBER COMPANY · WILLOUGHBY, OHIO

developed having a steel cap supported on a steel spider. Between the fingers of the spider, the light rays stream almost parallel to the ground. The crushing load is carried downward at an angle to the steel ring resting against the concrete of the cell. The new units, with mild-steel spiders, have repeatedly withstood loads of 150,000 lbs. With alloy steel, the units are reported to be good for better than 200,000 lbs. These increases in strength have been achieved without any increase in size. Dimensions are fixed by the fact that units must fit into existing concrete emplacements. Westinghouse Electric & Manufacturing Company.

Packaged Airport Equipment

Packaged airports that comprise all facilities for an installation of any size (except main terminals) are one of the latest developments to come from the war. Units include all power and electrical apparatus, radio equipment for communication between airports and planes, lighting for field and buildings, and meteorologic instruments. Prefabricated steel buildings are provided for administration, office, living quarters, and hangars. In addition, there are buildings for heating, plumbing, and sewage-disposal systems.

The new airport designs involve four sizes. The smallest and simplest is the emergency landing field that has only the barest essentials to accommodate a plane forced down. The next is an airport that could serve remote or isolated mines and ranches. It could also be used by business concerns in connection with property operation. Still larger is the feeder airport such as would serve smaller communities on branch airlines. Finally, the largest airport design would accommodate fair-sized towns that handle a considerable amount of air transportation business.

Airport equipment is designed for three temperature classifications—polar, temperate, and tropic. Each classification takes into account all conditions, including variation in temperature, moisture, wind, ice loading, insects, etc.

The plan provides for twelve types of main terminal buildings. Basic elements are correlated and reduced to a minimum number. This makes it possible to assemble almost any desired airport by the proper selection of basic units. It also permits expanding the facilities of any given airport as the need changes. Airports that must provide their own power are supplied by one or more standard Diesel-driven generators—units can be added when and if the power demand increases. Westinghouse Electric & Manufacturing Company.

Aircraft Arc Welder

An arc welder, designed especially for the needs of the aircraft industry, is now available for fabricating the variety of steel frames and parts used in modern airplanes. The new aircraft welder, having a current range of 10 to 200 amp., is of the alternating-current type, consisting of what may be called the basic welder, to which has been added a high-frequency arc stabilizer of new design. The basic welder consists of a natural-draft, air-cooled transformer and a stepless current selector of the moving-core reactor type, with a construction similar to that used in the larger sizes of the Westinghouse line of a.c. welders.

A feature of this new aircraft unit is the high-frequency arc stabilizer. While the use of high frequency to obtain arc stability is not new, the present from is said to extend the good features of the older designs and, in addition, to correct the radio interference troubles that were present in some of the older sets. The new arc stabilizer employs a double-tuned, loose-coupled oscillating circuit and is of the spark-gap type.

An additional powerful source of ionization for the arc space is provided by the high-frequency arc stabilizer. This auxiliary ionization is provided to improve the arc striking and welding for all values of current, giving satisfactory results at the lower current values where the need for ionization is the greatest.

The stabilizer produces the ionization through the medium of a small high-frequency "arc" that appears in the arc space as the welding arc is being struck and throughout the welding period. This stabilizing "arc" is maintained by a series of pulses of high-frequency energy, with several of these pulses being discharged during each half-cycle of the welding circuit. In the new welder, a circuit is used which causes these stabilizing arc pulses to be most effective when the need is greatest —that is, during the periods when the alternating current reverses in direction.

To give the operator control of the high-frequency oscillator, a special electrode holder is available for use with the welder. It consists of a new design trigger-activated pilot switch mounted on the handle of a standard electrode holder. With this control, the operator, with only a light touch on the trigger of the pilot switch, is able to energize the oscillator just before he starts to weld, so that the full benefit of the high-frequency stabilizer is available for easy arc striking as well as during welding. The release of the trigger disconnects the oscillator from the power circuit so that it is used only as needed for welding.

The makers claim that the new aircraft welder overcomes arc-blow difficulties and their accompanying troubles and that the machine is adaptable for use on a wide variety of metals with a wide variety of electrodes. Westinghouse Electric & Manufacturing Company.

Direct-Current Motors for Aircraft

Established and specific power requirements for each functional plane device have made possible the design of a coordinated basic line of aircraft motors.

These motors with accessories (brakes, clutches, gear-reduction drives, limit switches, etc.) are especially designed for the jobs they are called upon to perform. They operate landing-gear retractors, defroster fans, fuel pumps, booster pumps, flaps, trim tabs, blowers, cowl flaps, shutter doors, engine starters, propeller feathering, anti-icing pumps, deicing pumps, automatic pilot control, cabin superchargers, glider reels, turret control, ammunition loaders, bomb bay doors, windshield wipers, and hoists.

These d.c. aircraft motors vary in diameter from $1^{15}/_{16}$ to $6^{3}/_{8}$ in. Ratings range from $^{1}/_{300}$ hp. at 7,500 r.p.m. to 7 hp. at 7,500 r.p.m. based on continuous operation with self-ventilation. The ratings may be extended to 11 hp. at 7,500 r.p.m. by adding forced-air cooling.

Governors may be added to several of these motor sizes, when required to provide better speed regulation without complicated controls. Westinghouse Electric & Manufacturing Company.

High-Speed Electric Motor

What is called the world's fastest industrial motor—operating at 60,000 r.p.m.—has been designed to drive high-speed grinders for finishing internal surfaces of aircraft and tank engines.

Such grinders are now powered by larger, slower motors connected to the grinding-wheel shaft by belts and pulleys. The new high-speed motor would drive the grinder directly, eliminating production delays for belt replacements and increasing grinding accuracy. At top speed the rotor of the new motor travels more than 300 m.p.h. at its outside edge.

To meet the extremely fine tolerance required in finishing aircraft-engine parts, the grinding wheel must cut effortlessly and smoothly. Many of these grinding wheels are less than $^{1}/_{9}$ in. in diameter, no bigger than those used by dentists, but they must attain high speeds at their grinding edge.

Experience has shown that the best grinding speed is about 1 mile per min. on the face of the wheel. Electric current having a frequency of 1,000 cycles per sec. is employed to develop the speed of 60,000 r.p.m. This is supplied by motor-generator sets having an input frequency of 60 cycles per sec. The motor and its bearings are water-cooled, and lubrication is effected by oil under pressure. The bearings have a clearance of $^{2}/_{1,000}$ in.

In the future it is stated grinders may have to go to even higher speeds as tolerances grow smaller and smaller. Another motor is therefore being designed that will turn 120,000 r.p.m. Westinghouse Electric & Manufacturing Company.

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Institute News

Institute Awards

In addition to the Sylvanus Albert Reed Award announced in the January issue of the REVIEW, the following awards, given annually by the Institute at the Honors Night Dinner, were presented to the recipients at its Honors Night Dinner on January 24 at the Hotel Waldorf-Astoria in New York. A full account of the Honors Night Dinner will appear in the March issue of the REVIEW.

The Lawrence Sperry Award

William Benjamin Bergen, 28 years of age, was selected to receive The Lawrence Sperry Award for 1943. It is awarded annually for a notable contribution made by a young man to the advancement of aeronautics.

The Sperry Award, established by the Institute in 1936, is endowed by the brothers and sister of the late Lawrence Sperry, pioneer aviator and inventor, who met death by drowning at the age of 31 as the result of a forced landing in the English Channel in 1923.

Mr. Bergen is a graduate of the Massachusetts Institute of Technology. He joined the engineering department of The Glenn L. Martin Company in June, 1937, and performed static tests and general stress-analysis work until the end of the year, when he was assigned to the company's newly formed Vibrations Department. In August, 1939, he was made Chief Vibrations Engineer having charge of vibration, flutter, and dynamic loads work. He also was given charge of the vibrations laboratory and of experimental and development work on instrumentation.

In August, 1943, he was appointed Chief Flight Test Engineer, which position he holds at present. In addition to his former responsibilities in connection with vibration work, he now has charge of engineering work in connection with the flight testing of all Martin airplanes.

William Benjamin Bergen.

William H. McAvoy.

The Octave Chanute Award

William H. McAvoy was chosen to receive The Octave Chanute Award for 1943, given annually for notable contributions made by pilots to the aeronautical sciences.

The Award honors the memory of the American engineer, Octave Chanute, who died in 1910. He was a pioneer in aeronautical research and gave assistance and advice to the Wright Brothers in their early work.

Mr. McAvoy has been a test pilot for the National Advisory Committee for Aeronautics since 1921 and Chief Test Pilot since 1929. He is now Chief Test Pilot at the Ames Aeronautical Laboratory at Moffett Field, Calif. After graduation from Calvert Hall College and Maryland Institute of Applied Arts, he enlisted in the U.S. Army Air Corps in 1917, was commissioned as a Second Lieutenant, and served as Flight Instructor until his resignation from the Army in 1919. He has planned and executed hazardous flights that have furnished the major portion of the flight test data on all types and sizes of aircraft contained in N.A.C.A. reports.

The John Jeffries Award

Brig. Gen. Eugen G. Reinartz was the recipient of The John Jeffries Award for 1943, made annually by the Institute for outstanding contributions to the advancement of aeronautics through medical research. The John Jeffries Award was named after Dr. John Jeffries, Boston physician, who was the first American to make scientific observations from the air. He made a flight in a balloon with Blanchard, the French balloonist, in 1784 from London, taking recordings of the temperature, humidity, and density of the air. Dr. Jeffries also was Blanchard's passenger on the first aerial crossing of the English Channel, made in a balloon the construction of which was financed by Dr. Jeffries.

General Reinartz received his medical education at Medico-Chirurgical College, Philadelphia, graduating in 1916. He was commissioned in the Medical

Brig. Gen. Eugen G. Reinartz.

It Took a "Softie" To Absorb This Beating

AIRPLANE engines perform their miracles under brutal punishment. Enormous power must be concentrated in engines no bigger than your dining room table . . . engines that must develop one lusty horsepower for each cubic inch of cylinder area, yet weigh only one wee pound for each horsepower. Terrific impacts, loads and pressures tax the endurance of every part . . . four tons pressure per square inch of connecting rod surface area, just to mention one example. Bearing metals must have what it takes to withstand constant acceleration of incessant pounding and flexing wear at thousands of revolutions per minute.

Most metals cannot take it. Design engineers were stumped for a while to find the bearing metal that could stand up under such punishment. Then along came silver —"softie" of the ages, jeweler's pet and whipping boy for the monetary experts—silver, pegged in price and stored in vaults.

Silver turned out to be the toughest fighter of the lot. Silver, applied by the Mallosil* Process to Mallory Bearings, not only has the strength and endurance, but the anti-friction characteristics to absorb the worst beatings that air fighting can inflict on engines.

Today, almost every high output warplane engine relies on silver bearings for engine, reduction gear and supercharger bearings. Silver-bonded bearings, virtually nonexistent two years ago, now account for approaching 25% of the world's silver output. Mallory Bearings have won their spurs for dependability, longer wear, closer tolerances and the ability to take it under the most exacting conditions. Mallory engineering is regarded as the most advanced in new bearing techniques and engine makers look to Mallory facilities, expanded over and over again by War necessity, as reliable sources of supply.

Naturally, Mallory Bearings will be a great boon to postwar commercial aviation. But this is only one phase of the development. Wherever heavy duty, precision bearings are essential for improved engine performance—on the road, in plant and factory or elsewhere—Mallory Bearings have much to offer to design engineers, planning for the future.

Although Mallory Bearing production is concentrated on War effort, we shall be glad to consult on your problems and applications for the peace-time economy.

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*Reg. U.S. Pat. Off.

Lt. Col. Joseph J. George.

Reserve Corps in 1917 and entered active duty in August of that year. In December of 1917 he was commissioned First Lieutenant of the Medical Corps of the regular army and served during the war period with the Aviation Section of the Signal Corps.

In February, 1919, he was assigned to the Aeronautics Division of the Aviation Section of the Signal Corps and has had continuous service with aeronautics since that date. He subsequently served on various assignments throughout the United States and in the Philippine and Hawaiian islands. His promotion to the grade of Lieutenant Colonel was effected in 1937, and he was promoted to Colonel and Brigadier General in 1942.

General Reinartz is a Fellow of the American College of Physicians, a Fellow of the Aero Medical Association of the United States as well as President-Elect of that Association, an Honorary Member of the American Psychiatric Association, and a Member of the American Medical Association.

He has had the longest continuous service of any medical officer assigned to the Army Air Forces, having known no other service in more than 26 years of military duty.

The Robert M. Losey Award

Lt. Col. Joseph J. George is the recipient of The Robert M. Losey Award for 1943. He is serving as Chief of the Special Studies Section of the Weather Division Headquarters of the Army Air Forces, having taken war leave from his civilian work as Chief Meteorologist for Eastern Air Lines, Inc.

Colonel George was educated at the University of California in Los Angeles and at the California Institute of Technology. From 1929 to 1934 he was Chief Meteorologist for Western Air Express and later was appointed to his present civilian office. During his professional career he has served as consultant on research projects of the U.S. Weather Bureau.

In March, 1942, he received a commission as a Captain in the Army of the United States, was soon promoted to Major, and attained his present rank of Lieutenant Colonel in April, 1943. The section of which he is head makes studies of weather conditions used by staff agencies in planning military operations.

The Robert M. Losey Award was established by the Institute in 1940 in honor of the memory of Capt. Robert Moffatt Losey, an American officer in the Air Corps who was killed in Norway on April 21, 1940, while serving as an official observer for the U.S. Army. He was the first United States officer killed in World War II. The Losey award is made in recognition of outstanding contributions to the science of meteorology as applied to aeronautics.

The Thurman H. Bane Award

A new award in honor of Thurman H. Bane, to be presented annually to an officer or civilian of the Army Air Forces Matériel Command for an outstanding achievement in aeronautical development, was made to Lt. Col. Hollingsworth F. Gregory. In his capacity as project officer on helicopters, Colonel Gregory has been largely responsible for the development of several types of helicopters and is regarded as an authority on helicopter operations and construction, as well as a leading test pilot for this type of aircraft.

Unofficially, he holds all helicopter records, including the first mail flight, the first landing of a helicopter within a restricted space on the deck of a moving tanker, and numerous other pioneering accomplishments.

Col. Hollingsworth F. Gregory.

Colonel Gregory is a graduate of Mississippi College and has devoted his entire career to the Army Air Forces. In 1928 and 1929 he attended the primary and Advanced Flying schools at Brooks Field and Kelly Field, and in 1931 took an engineering course at the Air Corps Technical School at Chanute Field.

Since 1936 he has been engaged in rotating wing aircraft projects, his contributions including engineering data, design, and flight testing.

The Thurman H. Bane Award honors one of the most prominent technical officers of the U.S. Army Air Forces, who died in 1932. It has been endowed by Major R. H. Fleet and provides an annual certificate of citation and honorarium.

Institute Honors

Gen. Henry H. Arnold, Commanding General of the Army Air Forces, and Sir Richard Fairey, Director General of the British Air Commission, were elected Honorary Fellows of the Institute by secret ballot of Fellows and Honorary Fellows. The distinction of Honorary Fellowship is conferred upon not more than one individual in the United States, or more than one in a foreign country, in any one year.

The presentation and acceptance addresses will be printed in the March issue of the AERONAUTICAL ENGINEERING REVIEW.

Ten members of the Institute have been elected Fellows. To qualify as a Fellow of the Institute, a member must have been an Associate Fellow for at least a year and shall have attained a position of distinction in aeronautics. He shall have made notable and valuable contributions in one of the aeronautical sciences or aeronautical engineering.

Fellows are elected by ballot of the present Fellows and Honorary Fellows, and not more than ten members may be elected each year.

The Fellows elected were: Wellwood E. Beall, Vice-President in Charge of Engineering, Boeing Aircraft Company; Luis de Florez, President, De Florez Engineering Company, and Captain, U.S. Navy; Ivan H. Driggs, Principal Engineer, Bureau of Aeronautics, Navy Department; Jack Frye, President, Transcontinental & Western Air, Inc.; Edward H. Heinemann, Chief Engineer, El Segundo Division, Douglas Aircraft Company, Inc.; Boris V. Korvin-Kroukovsky, Chief Engineer, Edo Aircraft Corporation; Eugene E. Lundquist, Aeronautical Engineer, National Advisory Committee for Aeronautics; James M. Shoemaker, Chief Engineer, Chance Vought Aircraft Division, United Aircraft Corporation; John Stack, Research Engineer, National Advisory Committee for Aeronautics; Jesse G. Vincent, Vice-President of Engineering, Packard Motor Car Company.

These honors were conferred upon the recipients at the Honors Night Dinner of the Institute held on January 24 at the Hotel Waldorf-Astoria in New York.

Institute Officers for 1944

Wellwood E. Beall, Vice-President.

William K. Ebel, Vice-President.

Elmer A. Sperry, Jr., Vice-President.

Officers of the Institute for 1944 have been elected by the Council as follows:

President—MAJOR R. H. FLEET.

Vice-Presidents—WELLWOOD E. BEALL, Vice-President in Charge of Engineering, Boeing Aircraft Company; WILLIAM K. EBEL, Vice-President in Charge of Engineering and Chief Engineer, The Glenn L. Martin Company; ELMER A. SPERRY, JR., Vice-President, Sperry Products, Inc.; GEORGE M. WILLIAMS, Vice-President, Curtiss-Wright Corporation.

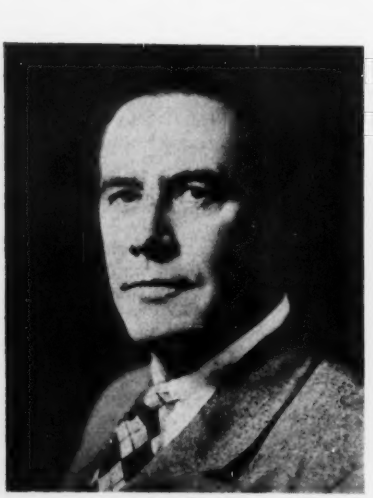
R. H. Fleet, President.

Treasurer—CHARLES H. COLVIN, Director, Daniel Guggenheim School of Aeronautics, New York University.

Chairman of the Council—LESTER D. GARDNER.

Administrative Committee—BENNETT H. HORCHLER, Executive Vice-President; GEORGE R. FORMAN, Assistant to the President; ROBERT R. DEXTER, Secretary; JOSEPH J. MAITAN, Controller.

Members of the Advisory Board for 1944 and new members of the Council will be announced in the March issue of the REVIEW.



George M. Williams, Vice-President.

Charles H. Colvin, Treasurer.

Lester D. Gardner, Chairman of the Council.

Bennett H. Horchler, Executive Vice-President.

Gifts to the Aeronautical Archives

A complete set of Aircraft Warning Service insignia was received from the Headquarters of the First Fighter Command through the courtesy of Brig. Gen. Glenn O. Barcus. Insignia of the Chilean and Uruguayan air forces were presented through Headquarters of the Army Air Forces and Brig. Gen. Robert W. Harper. Thirteen badges and emblems of air races and soaring meets from 1931 to 1940 were given by Earl R. Southee and Robert Southee.

A colored print of the Grumman G-44 "Widgeon" was given by the Ranger Aircraft Engines Division of Fairchild Engine and Airplane Corporation. A copy of W. J. Jackman's *Flying Machines, Construction and Operation*, Chicago, 1910, was received from Horace Keane. Two bibliographies, *Post-War Aviation* and *Air Freight*, were given by the Business Research Department of the Curtiss-Wright Corporation. Jose Garcia de Souza gave a copy of his *Historico do Aero Clube do Brasil*.

A set of drawings of the Esjay Military Tractor, designed by R. J. Hofmann and A. Stadleman of the Esjay Aero Company, Chicago, about 1912, was received from William B. Stout. A name plate from a Messerschmitt 109, shot down in the Tunisian campaign at El Aouina, near Carthage, was given by Lt. G. H. Robinson.

Earl R. Southee sent a name plate from the instrument board of a "Jenny." A fabric bookmark made from a fragment of the balloon "Explorer II" was received from T. M. Morgan.

A collection of glider clippings was received from Arthur Sherwood, of St. Louis, adding to previous gifts made through Major Gen. James H. Doolittle. Aviation magazines were received from F. W. S. Locke, Jr., including an issue of the *Southern Aviator* which was not previously in the collection. A complete set of its *Production Improvement Bulletins* was received from the Curtiss-Wright Corporation. The Eclipse-Pioneer Division of Bendix Aviation Corporation gave 400 numbers of aeronautical magazines. The Fairchild Engine and Airplane Corporation gave 325 numbers of aeronautical magazines. A collection of magazines, including a file of the *Air Commerce Bulletin*, was received from the National Safety Council through Leon Palmer.

Among the donors of other gifts were the Air Transport Association, British Information Services, General Electric Company, Pan American Grace Airways, Society of Experimental Stress Analysis, Thompson Products, Inc., United Airlines Transport Corporation, U.S. Department of Agriculture, National Bureau of Standards, Office of Civilian Defense, and the Aero-Medical Laboratory at Wright Field.

Robert R. Dexter, Secretary.

New Corporate Members

The following are brief summaries of the products and activities of companies that have recently become Corporate Members of the Institute.

Aerojet Engineering Corporation, Pasadena, Calif., is a prime contractor to the Army Air Forces, to the Navy, and to private companies that have been approved by the appropriate agency of the Government. It is engaged in broad applications of jet propulsion.

Ballard Aircraft Company, Inc., formerly the Hoosier Aircraft Company, Inc., was incorporated in 1942 with the long-range purpose of manufacturing civilian airplanes in plastic bonded plywood, but its entire facilities are now devoted to war production.

This company has manufactured and delivered aircraft components in wood and plastic bonded plywood, such as CG4 glider spars, spar flanges, turret-gunner seats, empennage assemblies, and complete wing panels with ailerons and flaps. At present, the company is engaged in extensive production of armament-training replicas and radio-training replicas in its plants located in Arthurdale, W.Va., and Elkhart, Ind.

Numerous small parts have been manufactured by Ballard Aircraft in plastic bonded plywood. The company has designed many types of pneumatic presses and has found this method of press operation desirable for both cold and hot processes. In addition to the production activities mentioned, an experimental department is maintained. At present, this department is engaged upon an experimental contract for the Government.

George R. Forman, Assistant to the President.

Ryan Aeronautical Company of San Diego, Calif., has for more than 20 years been active in the design, development, and manufacture of aircraft and assemblies, operation of flying and technical schools, and organization and operation of air lines. It is currently engaged in the design and development of a new and advanced type of combat airplane for the U.S.

Joseph J. Maitan, Controller.

Poker Face!

THE face of a meter is disarming enough. It can tell the truth or it can bluff without any change of expression. That's why you must look to the maker of the meter—rather than to the meter itself—for proof of responsibility and accuracy. If it is *made* right, it tells the truth.

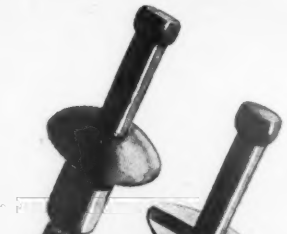
Boes measuring, metering, and testing instruments are built for *sustained accuracy**—to provide the sciences, the professions, and the world of production with instruments of character—instruments that never bluff—instruments that are built expressly for the service they are expected to render and the circumstances under which they must operate.

* **SUSTAINED ACCURACY** is not an easy quality to achieve. It must take into account all factors of use—must then employ the design, the alloys, the construction that infallibly protect an instrument against all threats to its reliable performance. Such instruments, obviously, must be built with performance—not price—in mind. We invite the inquiries of those who are interested in such standards.

Boes *instruments*

for Measuring, Metering & Testing Equipment

THE W. W. BOES COMPANY, DAYTON, OHIO



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Today Cherry Blind Rivets are plentiful—five times as many rivets as a year ago. Deliveries are current to an increasing number of customers.

In spite of this increase in our production, the quality of Cherry Rivets has been continually improved. Refinements in design and quality control have made Cherry Rivets more uniform—have improved their structural characteristics.

Chances are you can save time and money by using Cherry Rivets in more of the hard-to-get-at places. New types of Cherry Rivets to meet special applications are being developed. Why not put your problems before our Engineering Service Department?

★ We can start shipment immediately on new orders for Cherry Blind Rivets and tools for applying them.

CHERRY RIVETS, THEIR MANUFACTURE AND APPLICATION ARE COVERED BY U. S. PATENTS ISSUED AND PENDING.

Cherry Rivet *Company*

LOS ANGELES, CALIFORNIA

Navy. It has supplied primary military trainers to the U.S. Army and Navy and for use in many friendly foreign countries. Trainers of the PT-22 type are used at civilian contract flying schools. A seaplane model of the PT-22 has also been developed for instruction of pilots in water operation, and other models include the PT-25 plastic bonded plywood military primary trainer and the Dragonfly short-range liaison observation plane for the U.S. Army.

Through its Exhaust Systems Manufacturing Division, the company is one of the largest manufacturers of specialized engine manifolds and accessories and, while its new airplane project is being developed, is supplementing its aircraft work with the production of bomber assemblies. Ryan manifolds are used to power turbosuperchargers, dampen exhaust flame, and transfer heat for carburetion, cabin heat, wing anti-icing, gun installation heating, and warming of surface controls.

Simmonds Aerocessories, Inc., operating in conjunction with associated companies throughout the world, specializes in the development, engineering, and manufacture of aircraft and industrial equipment. The company's manufacturing units are located in California, Vermont, and New York, with offices also in Montreal, Washington, and Dayton. Simmonds' products include automatic engine controls, spark plugs, mechanical push-pull controls, hydraulic accumulators and fuses, chronometric radiosondes, and clips and fasteners.

Advanced engineering and precision manufacturing methods, together with constant interchange of information with associated companies, enable the company to take an important position in the development of new products of all types.

Sections and Branches

Akron Section

At regular monthly meetings for the last four months of 1943, papers were presented as follows: September 21, "Flight Test Procedure," by V. S. Kupelian of the Goodyear Aircraft Corporation, Akron, O. October 22, "Meteorological Fronts and Aviation," by P. O. Huss of the Daniel Guggenheim Airship Institute. November 19, "Engineer's Approach to Air Sickness," by Robert Mayne of the Goodyear Aircraft Corporation. December 17, "Aerodynamics in Border Fields of Aeronautical Engineering," by John R. Weske of Case School of Applied Science, Cleveland.

University of Alabama

The University of Alabama Student Branch held its last meeting of the Fall quarter on December 8. The meeting was featured by a talk on "Lofting Problems," by William Sleeman, and the film, *Wright Brothers Build for Air Supremacy*. Elections for the Winter quarter were held during the meeting and the following were elected: Chairman, John L. Potter; Secretary, Paul Comisarow. The applications of ten prospective new members have been submitted.

Oregon State College

At a business meeting on November 3, 1943, the following officers were elected: Chairman, Harold B. Uhlig; Secretary-Treasurer, Raymond M. Lockwood. However, shortly after the election, Mr. Uhlig was called to active duty with the Army Air Forces. The election of a Vice-Chairman was deferred and, since the Seniors were uncertain as to how long they would remain in college, it was considered desirable to elect a Junior to this position. During the 1942–1943 academic year, 16 student members and former members of the chapter have entered the armed forces and nine of them are now in the Army Air Forces. The applications of four prospective new members from the Junior class have been submitted.

University of Washington

At a short business meeting on December 8, James Briggs, a Junior, was elected Corresponding Secretary. An assessment of $0.25 each was decided upon, primarily to defray the cost of handling motion-picture films. It is planned to have either a speaker or a picture at each meeting in the future.

News of I.A.S. Members

Roy G. Adamson is Assistant Chief Project Engineer in the Aircraft Division of Designers for Industry, Inc.

Howard W. Barlow has been elected Chairman of the Aeronautics Committee of the Society for the Promotion of Engineering Education.

Maurice S. Bernstein has enlisted in the U.S. Army.

Seymour F. Bernstein has been commissioned a Second Lieutenant in the Army Air Forces.

Victor F. Boetel is now a Stress Analyst in the Fort Worth Division of Consolidated Vultee Aircraft Corporation.

Clarence B. Brown, Jr., has received his commission as an Ensign and has been assigned as Assistant Chief Draftsman & Technical Engineer in the Aircraft Armament Unit of the U.S. Navy.

William B. Champney is a Senior Aerodynamicist in the Research Laboratories of the Airplane Division of Curtiss-Wright Corporation.

John Christopher Dykes has gone to Egypt as Technical Officer of the British Airways Overseas Corporation at Cairo.

Gibb Gilchrist has been appointed Chairman of the Texas Postwar Economic Planning Commission.

Malcolm H. Gotterer has enlisted in the Army Air Forces.

Eugene D. Grim has returned to college as a student at Kansas State College.

Robert A. Holdahl has enlisted in the Army Air Forces.

W. Wallace Kellett resigned on December 31, 1943, as Chairman of the Board of Republic Aviation Corporation, but he will continue to serve as a member of the Republic Board of Directors. He is President of the Kellett Aircraft Corporation.

Paul Korody is now a Salvage Engineer with Westinghouse Electric & Manufacturing Company.

Sherman H. Lee has joined General Aircraft Corporation as Stress Engineer.

Thomas A. D. Lehr has been promoted to Assistant Project Engineer in the Jacobs Aircraft Engine Company.

Jerome Lederer, the new Chief Engineer of Aero Insurance Underwriters.

Robert W. Lilligren has enlisted in the Army Air Forces.

Rodger C. Lindstrom has joined the Aircraft Division of J. I. Case Company as Chief Structural Engineer.

Felix Nagel is the new Chief Engineer of the Aircraft Development Corporation.

Eli S. Newberger recently transferred to Taylorcraft Aviation Corporation as Assistant Chief of Structures.

Thomas Francis Paniszczyn has become an Aerodynamics Engineer in the Forth Worth Division of Consolidated Vultee Aircraft Corporation.

Roger A. Petrey has been commissioned a Lieutenant in the U.S. Marine Corps.

Daniel R. Ranney recently enlisted in the U.S. Naval Reserve as a Student Engineer.

Albert J. Rosenberg has entered the Government Service as Technical Consultant in the Division of Visual Aids of the U.S. Office of Education in Washington.

BACK THE ATTACK -- IT DRIVES THEM BACK
EPTHA DONUT
FOURTH WAR LOAN
FREE ENLARGEMENTS (14" wide) of this cartoon by Edmund Duffy, twice winner of the Pulitzer Prize, are available. Write, on your business letterhead, to: Bruce Livie, President, Liberty Motors & Engineering Corp., Baltimore-1, Md.
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For Complete, Accurate Tests of
Aircraft Pumps of All Types
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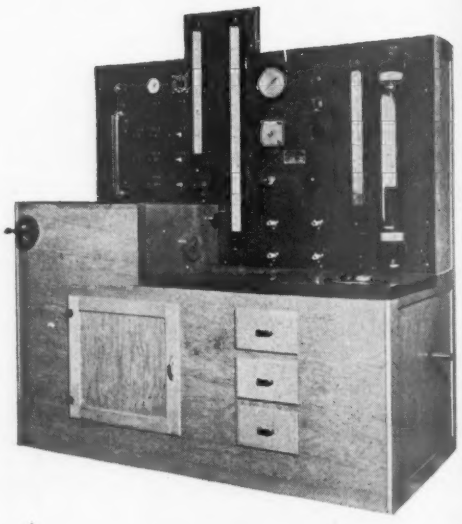
This Liberty Test Unit (Type 111) checks both vacuum and hydraulic pumps at speeds from 700 to 5200 R.P.M. For Vacuum Pumps, input suction and output pressure are shown directly in inches of mercury; air flow may be read from 0 to 50 c.f.m. For Hydraulic Pumps, input suction is shown in inches of mercury; output pressure on a 0-to-4000 p.s.i. pressure gauge. Flowmeter reads from 1.5 to 12 g.p.m. hydraulic fluid. This Liberty test bench is ideal for permanent bases, rear echelon repair, check-ups, and for plane builders. Write for complete information.



LIBERTY MOTORS
& ENGINEERING CORPORATION
BALTIMORE-1, MARYLAND

MANUFACTURERS OF AIRCRAFT SERVICE TOOLS AND TEST EQUIPMENT

Earl P. Rothgeb joined Douglas Aircraft Company, Inc., as Liaison Engineer at the company's Modification Center.

Robert H. Scanlan is now a Senior Stress Analyst in the Eastern Aircraft Division of General Motors Corporation.

Dean C. Smith has joined the executive staff of Fairchild Engine and Airplane Corporation and is in charge of development activities.

Kenneth E. Smith is a Project Engineer in the office of Peter Altman, Consulting Engineer.

Richard H. Stetson has been appointed Junior Passenger Agent for Transcontinental & Western Air, Inc., at the Philadelphia Airport.

George Tankersley has been commissioned an Ensign in the U.S. Naval Reserve.

Luis F. Vasconez is now at the National Airport for Transcontinental & Western Air, Inc.

Kurt Wagenknecht has enlisted in the Army Air Forces as an Aviation Cadet.

William W. Wagner has joined Consolidated Vultee Aircraft Corporation as a Stress Analyst in the Structures Department of the Forth Worth Division.

Lt. Col. Raycroft Walsh, formerly Senior Vice-President of United Aircraft Corporation, has been made a Vice-Chairman of the corporation.

Vernon D. Westfall recently joined McDonnell Aircraft Corporation as Engineering Draftsman.

Eugene E. Wilson had relinquished the office of President of United Aircraft Corporation in order to devote his entire time to his duties as Vice-Chairman of the corporation.

Joseph A. Wisely has enlisted in the U.S. Navy as an Aviation Cadet.

Robert P. Wold received his commission as an Ensign in the U.S. Naval Reserve.

Members Elected

The following applicants for membership or applicants for change of previous grade have been admitted to membership in the grades indicated since the publication of the list in the last issue of the REVIEW.

Elected to MEMBER Grade

Adams, Ralph D., B.S. in Ae.E.; Designer, North American Aviation, Inc.

Adamson, James McLeod, B.S. in M.E.; Structural Engineer, Consolidated Vultee Aircraft Corp.

Albright, Penrose Strong, Ph.D.; Prof., University of Wichita.

Bean, Arthur Douglas, Stress Analyst, North American Aviation, Inc.

Beskin, Leon, Sr. Stress Analyst, Consolidated Vultee Aircraft Corp.

Biederman, Alfred, Instructor, Aircraft Instruments, University of Southern California; Mgr. & Engineer, A. Biederman.

Bowers, Herbert Lee, B.Ae.E.; Chief Development Engineer, Bell Aircraft Corp.

Bradley, J. R., Group Leader, Structures Engineer, Goodyear Aircraft Corp.

Bruchiss, Louis, Project Engineer, Group Leader, Simmonds Aerocessories, Inc.

Collins, Duncan R., Group Engineer (Wings), Airplane Div., Curtiss-Wright Corp.

Conners, James Milton, B.S. in Physics; Power Plant Engineer, Grumman Aircraft Engineering Corp.

Czerwinski, W., M. & Ae.E.; Chief Engineer, Canadian Wooden Aircraft Ltd., Canada.

Decat, Robert, Owner & Pres., R. Decat & Airsealand Aircraft, Inc.

Edenquist, Arvid Gunnar, B.Sc.; Vice-Pres., Kinner Motors, Inc.

Finnimore, John Ronald, Asst. Chief Draughtsman, British Overseas Airways Corp., England.

Germano, Frank J., D.C.E.; Assoc. Prof. of Engineering Mechanics, Louisiana State University.

Gilmore, John Joseph, Supt. of Maintenance, Transport Command, R.A.F.

Hoskins, Edmund Emanuel, B.S.; Vice-Pres., Consolidated Engineering Corp.

Kahn, Robert Frank, B.Ae.E.; Stress Analyst, Universal Moulded Products Corp.

Lazarus, William Chester, B.S. in M.E.; Major, U.S. Army Air Forces; Director, Glider Project Unit, Exp. Engineering Div., Matériel Command.

Love, Robert MacLure, Col., U.S. Army Air Forces; Deputy Chief of Staff, Air Transport Command.

Marin, Joseph, Ph.D.; Prof. of Engineering Mechanics, The Pennsylvania State College.

McDowell, William Woods, B.S. in C.E.; Technical Editor of *Plane Tips, Technographs,* The Glenn L. Martin Co.

McFarlan, Ronald Lyman, Ph.D.; Director of Research, Bulova Watch Co.

Morrison, Robert Laurance, B.A.Sc.; Technical Rep., Airspeed (1934) Ltd.

Robertson, James Mueller, Ph.D.; Asst. Prof. of Engineering Mechanics, School of Engineering, The Pennsylvania State College.

Robinson, Victor, M.D.; Prof. of History of Medicine, Temple University School of Medicine.

Schwarzenbach, Jean Christophe, Prof. Deg. Ae.E.; Pres. & Gen. Mgr., U.S. Propellers, Inc.

Sweet, Arthur Jeremiah, A.B.; Assoc. Airport Engineer, Technical Development Div., C.A.A.

Van Thullenar, Clayton Francis, B.A.; Chief Forecaster (New England District), U.S. Weather Bureau.

Wilson, Herbert A., Jr., B.S. in Ae.E.; Head of Full Scale Wind Tunnel, Langley Mem. Aero. Lab., N.A.C.A.

Wisnicki, Boleslaw Paul, Ae.E.; Chief Designer, Canadian Wooden Aircraft Ltd., Canada.

Woodward, Walter Ray, M.S. in M.E.; Research Aerodynamicist, Bell Aircraft Corp.

Transferred to MEMBER Grade

Forney, Adrian Kenneth, M.S. in Ae.E.; Assoc. Aero. Engineer, Navy Dept., U.S. Navy.

Nagamatsu, Henry Takeshi, M.S. in Ae.E.; Theoretical Research Aerodynamicist, Airplane Div., Research Lab., Curtiss-Wright Corp.

Swanson, LeRoy Douglas, B.Ae.E.; Sr. Stress Analyst, The Glenn L. Martin Co.

Zeitlin, Eli Arnold, B.S. in M.E.; Aero. Engineer, C.A.A.

Elected to Industrial Member Grade

Edgerton, John Warren, Account Executive, Brown Brothers, Harriman & Co.

Haring, Warren Frederick, E.E.; Mgr., Flasher Sales Dept., Wallace & Tiernan Products, Inc.

MacDonald, Grant, Pres. & Gen. Mgr., MacDonald Bros. Aircraft Ltd., Canada.

Nuss, Melvin H., Secretary, Mgr., Reading Municipal Airport.

Scragg, George Henry, Director of Advertising, The White Motor Co.

Elected to Technical Member Grade

Brewer, Chauncey Marble, Weight Analyst, Hughes Aircraft Co.

Danias, Michael George, B.Ae.E.; Operations Engineer, American Export Airlines, Inc.

Evans, John Francis, B.S.; Aerodynamicist, Bell Aircraft Corp.

Graham, Glenn Erwin, B.Sc.; Project Group Engineer, Wichita Div., Boeing Airplane Co.

Horwood, Edgar Miller, B.S. in M.E.; Preliminary Design Engineer, Boeing Aircraft Co.

Jung, Gustave Kingman, M.E.; Engineer, Aerodynamics Section, Aircraft Div., Curtiss-Wright Corp.

Marble, Theodore Francis, B.S. in M.E.; Stress Engineer, Sikorsky Aircraft Div., United Aircraft Corp.

Mayne, Robert, B.S. in E.E.; Development Engineer, Goodyear Aircraft Corp.

McAleer, William Kearns, B.S.; Project Engineer, Military Products Dept., Mine Safety Appliances Co.

Mills, Frederick, B.M.E.; Research Analyst, El Segundo Div., Douglas Aircraft Co., Inc.

Nielsen, Lars Creer, B.S. in M.E.; Jr. Engineer, Airplane Div., Curtiss-Wright Corp.

Oberleitner, Paul, B.S. in C.E.; Jr. Engineer, Stress Analyst, Airplane Div., Curtiss-Wright Corp.

Plaszczak, Thaddeus Roman, B.Sc. in Ae.E.; Lead Inspector, Consolidated Vultee Aircraft Corp.

Provenzo, Nicholas B., Asst. Group Engineer, Bell Aircraft Corp.

Richard, George Joseph, B.S. in M.E.; Stress Analyst, Class A, Northrop Aircraft, Inc.

Rozelle, Tracy Martin, Jr., Jr. Engineer, Airplane Div., Curtiss-Wright Corp.

Snook, John D., Jr., U.S. Army Air Forces.

Willard, Gordon Raymond, Major Layout Engineer, Lead Checker, Boeing Aircraft Co.

SHENANGO-PENN

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are NOT a Substitute

THE aviation industry has eagerly accepted new methods which will speed production and increase the performance of planes. Some of those accepted are considered as wartime substitutes, but centrifugal casting has proved its worth to stand on its own feet.

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Don't look on Shenango-Penn centrifugal castings as a substitute. Their greater strength and purity, and their assured quality may be a better answer to some of your problems. Let us send you a copy of our Bulletin No. 143. It will give you the story of our process, products and alloys, and enable you to decide where centrifugal castings may best fit into your work.

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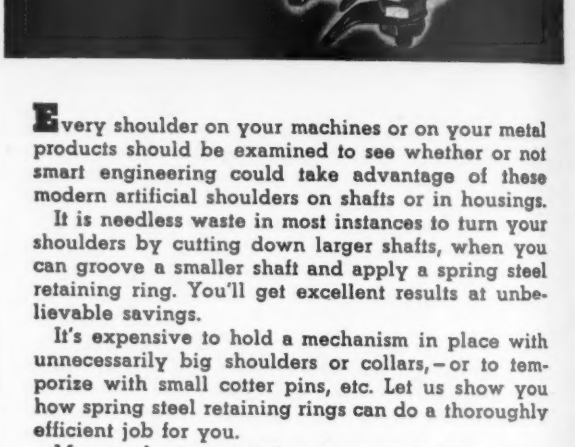

Transferred from Student to Technical Member

Bialeck, Alvin Morton, B.Ae.E.; Aerodynamicist, Fort Worth Div., Consolidated Vultee Aircraft Corp.

Boatright, William Bromley, B.S. in Ae.E.; Engineering Asst., Factory "A," Lockheed Aircraft Corp.

Brown, Sherwood Hulett, B.S. in Ae.E.; Aero. Engineer, Ames Aero. Lab., N.A.C.A.

Dickson, John Albee, B.S. in Ae.E.; Liaison Engineer, Georgia Div., Bell Aircraft Corp.

Engel, William Newman, B.S. in Ae.E.; Private First Class, U.S. Army.

Foester, Hallard Lewis, B.S. in Ae.E.; Detailed Draftsman, Consolidated Vultee Aircraft Corp.

Gardner, Robert Elmer, Jr. Engineer, Research Lab., Curtiss-Wright Corp.

Giarratana, Salvatore Anthony, B.A.E.; Aerodynamic Engineer, Hamilton Standard Propellers Div., United Aircraft Corp.

Gilbert, Charles Jan, B.S. in Ae.E.; U.S. Army Air Corps Engineers, Reserve.

Glaza, G. Keith, The Dow Chemical Co.

Guske, James Augustus, B.S. in Ae.E.; Aviation Cadet, U.S. Army Air Forces.

Hollenberg, Harold Oscar, B.S. in Ae.E.; Officer Candidate, U.S.N.R.

Keeney, Joseph, Jr., B.S. in Ae.E.; Apprentice Engineer, Pan American Airways, Inc.

Kelley, Edward Frederick, M.S. in A.E.; Aerodynamicist, Consolidated Vultee Aircraft Corp.

Kessler, George, B.A.; Stress Analyst, Hughes Aircraft Co.

Lampert, Seymour, B.S. in Ae.E.; Instructor, Georgia School of Technology.

Lieberman, William Sanford, B.S. in M.E.; Stress & Aerodynamic Engineer, Commonwealth Aircraft Co.

McDonald, Lawrence Herbert, B.S. in Ae.E.; Ensign, U.S.N.R.

Morduchow, Morris, B.Ae.E.; Research Fellow for N.A.C.A.; Polytechnic Institute of Brooklyn.

Ness, Nathan, B.S. in Ae.E.; Jr. Engineering Asst., Lockheed Aircraft Corp.

Nowicki, Henry Theodore, B.S. in Ae.E.; Flight Engineer, Douglas Aircraft Co., Inc.

Ross, Sol Alexander, B.S. in M.E.; Jr. Aerodynamics Engineer, Chance Vought Aircraft Div., United Aircraft Corp.

Rowland, Arthur Edward, B.S. in Ae.E.; Structures Engineer, Aeronca Aircraft Corp.

Scott, Roger Lewis.

Simmons, Roger C., Engineer, Propeller Div., Curtiss-Wright Corp.

Strass, Herbert Kurt, B.S. in Ae.E.; Instructor & Research Asst., Georgia School of Technology.

Swanson, Jacob Barto, Jr., Aviation Cadet, U.S. Army Air Forces.

Thorson, Harley Morris, Project Engineer, Northwest Airlines, Inc.

Tischler, Asher, Engineer, Propeller Div., Curtiss-Wright Corp.

Veeneman, Robert Stuart, B.S. in Ae.E.; Ensign, U.S.N.R.

Wilson, Glen Parten, Jr., B.S. in Ae.E.; Engineering Trainee, Lockheed Aircraft Corp.

Elected to Affiliate Grade

Rosenblum, Daniel D., Sergeant, U.S. Army Air Forces.

Shen, Yuin Chien, M.S. in Ae.E.; Engineering Officer & N.Y. Liaison Officer, Commission on Aero. Affairs, China.

Necrology

Francis Percy Hyde Beadle

Francis Percy Hyde Beadle, an Associate Fellow of the Institute and Fellow of The Royal Aeronautical Society, died suddenly on December 14, 1943, in London, Ontario, Canada. He was Chief Aeronautical Engineer of Central Aircraft, Ltd., in that city.

Prior to his connection with Central Aircraft, Mr. Beadle had held the office of Chief Aeronautical Engineer with The de Havilland Aircraft of Canada, Ltd., for a period of years.

Second Lt. Joseph Brannon Dooley, Jr.

Second Lt. Joseph Brannon Dooley, Jr., died on October 30, 1943, while on active duty with the Army Air Forces.

Lieutenant Dooley was born in Amarillo, Tex., on September 29, 1920, and attended Amarillo Junior College from September, 1937, to June, 1938. This was followed by a course at the University of Texas from September, 1938, to June, 1942, when he was graduated with the degree of Bachelor of Science in Mechanical Engineering.

In the same month he entered the employ of Douglas Aircraft Company, Inc., at Santa Monica, Calif., as a student engineer and worked in various engineering groups, learning the functions and operations of each. In December, 1942, he resigned to enter the Army Air Forces as an Aviation Cadet.

Dr. James Henry Kimball

Dr. James Henry Kimball, a Fellow of the Institute since 1934 and one of its founder members, passed away suddenly at his home in New York on December 21. He had served as a member of the Council of the Institute from 1933 to 1936, from 1938 to 1940, and from January, 1943, to his death. He was a member of the Advisory Board in 1937. In addition to numerous other activities, he was the Principal Meteorologist of the U.S. Weather Bureau at New York, having been connected with that department since 1895.

A native of Detroit, where he was born February 12, 1874, Dr. Kimball's professional education included degrees as follows: Bachelor of Science, Michigan Agricultural College, 1912; Master of Arts, University of Richmond, Virginia, 1914; Doctor of Philosophy, New York University, 1926; Honorary Doctor of Science, Michigan State College, 1934. He had been awarded many other honors, including the following: Fellow of the American Meteorological Society; Fellow of the American Association for the Advancement of Science; Fellow of the American Geographical Society; National Institute of Social Sciences; Member D' Honneur Lique Internationale des Aviateurs; awarded scroll of honor with gold medal, City of New York; Officer's Cross, Order Polonia Restituta; Chevalier, Legion of Honor, France; Commandatore of the Crown of Italy. He also held memberships and honors in other scientific societies.

In his capacity as meteorologist he had served in all parts of the United States and in the West Indies. He made great contributions to the advancement of the aeronautical sciences because of the information and advice that he gave to airmen and the assistance he rendered to many pioneer flights, including those of Admiral Byrd, Charles A. Lindbergh, Clarence D. Chamberlin, Roger Q. Williams, Lewis A. Yancey, and many others. In addition to his work in meteorology, Dr. Kimball carried on extensive research in related subjects and was the author of numerous books and articles on the subject of meteorology and its effects upon aeronautics.

In an editorial on December 22, 1943, the *New York Times* paid the following tribute to Dr. Kimball:

"There are many men who will regret the passing of Dr. James H. Kimball, head of the United States Weather Bureau in New York, but none more than the early ocean fliers whose lives depended on his judgment, or those who go down to the sea in ships in these dangerous times, and who often paid a last-minute call to his office.

"He had many interests, and those in charge of all sorts of business that might be affected by weather sought his advice; but Dr. Kimball's greatest pleasure probably came in applying his science of meteorology to make flying safer. It was on his advice that Lindbergh took off for Paris after a rainy night. It was he also who gave the departure signal to Byrd and Chamberlin on their transatlantic flights. Weather in its effect on aviation had been his hobby since the last war.

"Frail in appearance, he had a sturdy soul, which sought and found vicarious adventure in his lofty room overlooking the harbor."

Personnel Opportunities

This column is for the use of individual members of the Institute seeking new connections and organizations offering employment to aeronautical specialists. Any member or organization may have requirements listed without charge by writing to the Secretary of the Institute.

WANTED

Aeronautical Engineers urgently needed by Consolidated Vultee Aircraft Corporation, Fort Worth Division, to execute program of extensive development of large aircraft. Applicant must have technical training and

not presently employed in essential war industries. Apply direct to 921 Lamar Street, Fort Worth, Tex.

Graduate Engineers for essential war work, opportunity for advancement and increased earnings. Aeronautical experience not necessary. Must be citizen not employed in essential war industry or have certificate of availability from the U.S. Employment Service Office or War Manpower Commission of your area. Write direct, stating school, age, degree, experience, draft classification, and marital status to Consolidated Vultee Aircraft Corporation, Industrial Training Division, San Diego, Calif.

Aircraft Engineers needed by a progressive aircraft company with openings for group engineers to cover hydraulics, landing gear, and controls. Also positions available for a materials and process engineer, service engineer, procedures engineer, and several aircraft checkers. Those presently employed in essential war work need not apply. Airmail complete detailed information regarding education, experience, salaries, former employers, age, family status, citizenship, draft status, in order that we may be able to evaluate your qualifications from the first letter. Higgins Aircraft, Inc., P. O. Box 32, New Orleans 6, La.

Engineers—Aeronautical, Mechanical or Electrical; good opportunity available for designing and project development work. Must be citizen not employed in essential war industry or have proper certificate of availability. Write, giving full particulars including draft status to Box 212, Institute of the Aeronautical Sciences.

Aircraft Power Plant Engineer by leading Aircraft Accessory Manufacturer on exceptionally interesting and new developments, excellent possibilities for the future with company located in Ohio and California. Address inquiries to Box 206, Institute of the Aeronautical Sciences.

Aeronautical Engineers are being sought by the U.S. Civil Service commission for various Federal agencies whose activities are vitally necessary to the prosecution of the war. Particularly needed are aeronautical engineers with experience in the design, research, and development of airplanes and related equipment. Engineers with a general knowledge of the aeronautical field can also be utilized. Agencies with the most critical needs are the Navy Department, the War Department, and the Civil Aeronautics Administration. Most of the positions are in Washington, D.C., but some vacancies exist throughout the United States. Salaries vary in accordance with the duties and responsibilities of the positions and range from $2,433 to $5,228 per annum (including overtime pay) for a 48-hour workweek.

Applicants may secure the Engineering Examination Announcement No. 282 and application forms from first- and second-class post offices; from Civil Service Regional Offices; or from the U.S. Civil Service Commission. Applications should be filed with the Civil Service Commission, Washington 25, D.C.

AVAILABLE

Engineer, Graduate, Aeronautical, and commercial pilot, over 5 years' aircraft experience, including service as design, flight test, and project engineer, demonstration and check pilot, desires responsible position furthering use and expansion of this experience. Available April. Address inquiries to Box 211, Institute of the Aeronautical Sciences.

Aeronautical Engineer, B.S. in A.E., with 10 years' experience in teaching Aeronautical Engineering and Engineering Mechanics, possesses valid A and E License. Desires position in University or Industry in South or Southwest. Address inquiries to Box 210, Institute of the Aeronautical Sciences.

Aeronautical Engineer, Brazilian M.S., M.I.T., returning home after a seven months' tour of the U.S. Aircraft industry, desires contact with companies interested in development of South American Market. Address inquiries to Box 209, Institute of the Aeronautical Sciences.

Aeronautical Engineering Executive, age 42, 9 years' experience in mechanical and structural engineering; 10 years' well-rounded experience in aircraft design, manufacturing and service engineering, desires new connection with commercial aircraft manufacturer or air line as assistant chief engineer, chief designer or chief project engineer. Experience includes collaboration on both commercial and military aircraft. West Coast preferred but willing to consider other location. Address inquiries to Box 208, Institute of the Aeronautical Sciences.

Aeronautical Engineer, B.S. in Physics, 3 years' experience aerodynamics, 6 years' miscellaneous production engineering. Desires position as research and development engineer with postwar private plane and helicopter manufacturer. Address inquiries to Box 207, Institute of the Aeronautical Sciences.

Aeronautical Engineer recently discharged Army Air Forces, formerly executive Chief Engineer and Consultant, desires new connections either permanent or consulting. Address inquiries to Box 205, Institute of the Aeronautical Sciences.

Aeronautical Engineer, B.S. in M.E. (Aero Option), with over 4 years' experience in design and supervision wishes to become associated with a consulting engineer or group in the Philadelphia area. Address inquiries to Box 202, Institute of the Aeronautical Sciences.

Aeronautical Engineer, B.S. in Ae.E., age 26, 2 years' experience stress analyst and structural engineer with Navy Department; possesses valid commercial, instructor, instrument and 675-hp. ratings; 1,300 hours' time. Desires position involving flight engineering and testing. Address inquiries to Box 200, Institute of the Aeronautical Sciences.

Graduate Engineer, 10 years' practical experience in design and development of aircraft armament including power-operated gun turrets; 50-caliber and 20-mm. fixed installations. Experience obtained with leading American and British Gun Turret Builders; desires position as Design Engineer or Executive with progressive aircraft concern. Address inquiries to Box 198, Institute of the Aeronautical Sciences.

Aeronautical Engineering Executive, Scottish born Canadian Citizen, age 42, 9 years' experience, all phases aircraft engineering; 10 years', mechanical engineering; 5 years', electrical engineering; 4 years', marine engineering; desires responsible executive position; immediately available, willing to work anywhere in United Nations territory. Address inquiries to Box 195, Institute of the Aeronautical Sciences.

Structural Aeronautical Engineer, 20 years' military and commercial aircraft engineering, including design supervision, liaison, and coordination. Desires responsible project or position as engineering representative on large cargo planes. Draft status does not effect change. Available in 30 days. Address inquiries to Box 194, Institute of the Aeronautical Sciences.

Aeronautical Engineer, M.I.T. graduate, age 37, 14 years' practical and well-rounded experience on aircraft design, supervision, executive, wide organization background. Held positions as project engineer, assistant chief engineer, chief aeronautical engineer. Desires permanent position as chief engineer or similar. Willing to go into partnership. Location preferred, Los Angeles or extended area, or South America. Address inquiries to Box 153, Institute of the Aeronautical Sciences.

Institute of the Aeronautical Sciences Twelfth Annual Meeting

FINAL PROGRAM

The program below lists the papers presented at the Technical Sessions of the Twelfth Annual Meeting of the Institute held in New York, January 25–27, 1944.

Individuals desiring preprints of papers for personal use should make their requests directly to the authors of the papers desired. Company library requests may be addressed to the Institute.

Tuesday January 25

AIRCRAFT PRODUCTION

1:30 p.m. Room 401

Chairman

Frederic Flader, Airplane Division, Buffalo Plants, Curtiss-Wright Corporation

The Trend of Wood Use in Aircraft—R. W. Hess, Airplane Division, Research Laboratory, Curtiss-Wright Corporation.

Resin Adhesives for Aircraft—Henry Grinsfelder and Thomas D. Perry, The Resinous Products & Chemical Company, Inc.

Demagnetization During Magnetic Particle Inspection—M. Mages, Magnaflux Corporation.

The Use of Cast Plastics for Aircraft Tooling—Leonard Weiss, Brewster Aeronautical Corporation.

STRUCTURES

1:30 p.m. Room 428

Chairman

Walter Ramberg, National Bureau of Standards

Three Dimensional Analysis of Engine Mount Rings by a Strain Energy Method—Charles E. Mack, Jr., Grumman Aircraft Engineering Corporation.

Preliminary Structural Analysis and Weight Investigation of Wings—Fletcher N. Platt, Fleetwings Division, Kaiser Cargo, Inc.

Flexural Strength in the Plastic Range of Rectangular Magnesium Extrusions—F. A. Rappleyea and E. J. Eastman, The Dow Chemical Company.

Plastic Bending—William R. Osgood, National Bureau of Standards.

Buckling Loads of Beams or Plates on Continuous Supports—Edward Saibel, Carnegie Institute of Technology.

AIR TRANSPORT

7:30 p.m. Room 401

Chairman

John C. Leslie, Pan American Airways, Inc.

Traffic Control Problems for Future Airports—M. G. Beard, American Airlines, Inc.

Daylight Training of Pilots for Night Flying—J. G. Beebe-Center, L. Carmichael, and L. C. Mead, Tufts College.

The Correlation of Aircraft Takeoff and Landing Characteristics with Airport Size—A. L. Morse, Civil Aeronautics Administration.

Aircraft Hangars and Terminal Buildings of Reinforced Concrete—Charles S. Whitney, Consulting Engineer.

MATERIALS

7:30 p.m. Room 428

Chairman

George W. DeBell, Consulting Engineer

High Strength Casting Alloy With Natural Re-aging Properties—Hiram Brown, Frontier Bronze Corporation.

Parts from Metal Powders—Carl Claus, Bound Brook Oil-Less Bearing Company.

Roll-Formed Sections of 24S and Alclad 24S Aluminum Alloy—Thomas H. Huff, Brasco Manufacturing Company.

New Wrought Aluminum Alloys for Aircraft and New Temper Modifications of Present Alloys—D. A. Lawless, Reynolds Metals Company.

Indium in Aviation—William S. Murray, The Indium Corporation of America.

Engineering Applications of Design-Strengthened Materials—Dimitry E. Olshevsky, Aero Research Company, and Richard S. Smith, Rigid-Tex Corporation.

Wednesday January 26

AERODYNAMICS, Part I

1:30 p.m. Room 401

Chairman

Richard H. Smith

Massachusetts Institute of Technology

The Influence of Structural Deformation on Aerodynamic Characteristics of the Airplane—Alexander Flax, Airplane Division, Buffalo Plants, Curtiss-Wright Corporation.

Fuselage Influence on the Airflow at the Propellers of a Multi-Engine Airplane in Yawed Flight—R. P. Harrington and Victor Zadikov, Polytechnic Institute of Brooklyn.

Aero-Economics—James B. Kendrick, Lockheed Aircraft Corporation.

Some Two Dimensional Adiabatic Compressible Flow Patterns—Hans Kraft and Charles G. Dibble, General Electric Company.

Drag of Airfoils in Grids of High Solidity—John R. Weske, Case School of Applied Science.

RADIO AND INSTRUMENTS

1:30 p.m. Room 428

Chairman

Alan G. Binnie

Kollsman Instrument Division, Square D Company

Flight Research Instrumentation of the Single Seat Fighter—Stephen B. Elggren, Bell Aircraft Corporation.

Development of Stall Warning Indicators—James George, Civil Aeronautics Administration.

The Electronic Turboregulator—W. H. Gille and H. T. Sparrow, Minneapolis-Honeywell Regulator Company.

Aircraft Remote Controls and Automatic Controls—Richard M. Mock, Lear Avia, Inc.

Measurement of Rate of Flow by Means of an Oscillating Vane—P. Weiller, Victor E. Carbonara, and Arleigh Van Nostrand, Kollsman Instrument Division, Square D Company.

ANNUAL BUSINESS MEETING

5:00 p.m. **Room 401**

Reports of Officers and Election of Council Members

AERODYNAMICS, Part II

7:30 p.m. **Room 401**

Chairman

R. P. Harrington, Polytechnic Institute of Brooklyn

The Thermodynamics of Air at High Velocities—Neil P. Bailey, General Electric Company.

Effect of Dive Brakes on Airfoil and Airplane Characteristics—Philip G. Blenkush, University of Detroit; Raymond F. Hermes, Aeronca Aircraft Corporation; and Merle A. Landis, Airplane Division, Curtiss-Wright Corporation.

Airfoil Theory for Flows of Variable Velocity—Rufus P. Isaacs, Hamilton Standard Propellers Division, United Aircraft Corporation.

POWER PLANTS AND PROPELLERS

7:30 p.m. **Room 428**

Chairman

George W. Brady

Propeller Division, Curtiss-Wright Corporation

Stability of a System Acted upon by a Plurality of Co-acting Automatic Controls—C. W. Chillson, R. J. Kochenburger, and P. J. Quinn, Propeller Division, Curtiss-Wright Corporation.

Aircraft Powerplant Fire Protection—H. L. Hansberry, Civil Aeronautics Administration.

The Theory of the Centrifugally Tuned Vibration Absorber—Ralph J. Harker, Hamilton Standard Propellers Division, United Aircraft Corporation.

Application of the Variable Ratio V-Belt Principle in the Design of a Constant Speed Propeller—Lloyd H. Leonard, Aircraft Specialties Division, Zimmer-Thomson Corporation.

Propeller Design Requirements—H. M. McCoy, Propeller Laboratory, Engineering Division, Matériel Command, U.S. Army Air Forces, Wright Field.

Thursday January 27

AIRPLANE DESIGN

1:30 p.m. **Room 401**

Chairman

Frederick K. Teichmann, New York University

Soundproofing of Military Aircraft—Albert A. Arnhym, Solar Aircraft Company.

Aircraft Industry French Technique 1941-42—Alex M. Gorfin, Matam Corporation.

Structural Causes of Injury in Light-Aircraft Accidents—Hugh De Haven, Department of Physiology, Cornell University Medical College.

Radiant Energy Exchange as a Factor in Airplane Cabin Heating—F. W. Hutchinson and B. F. Raber, University of California.

Directional Stability of Flying Boat Hulls During Taxiing—John D. Pierson, The Glenn L. Martin Company.

Impact Resistant Windshield Construction—G. L. Pigman, Civil Aeronautics Administration.

METEOROLOGY, PART I

Session Prepared in Cooperation with the American Meteorological Society

1:30 p.m. **Room 428**

Chairman

C. E. Buell, American Airlines, Inc.

Causes of Nighttime Thunderstorms Over the Middle West—Donald M. Crowley, Transcontinental & Western Air, Inc.

Contribution to Nocturnal Instability by Advection—Lynn L. Means, University of Chicago.

Methods of Estimating or Determining the Heights and Motions of Clouds—Charles F. Brooks, Blue Hill Meteorological Observatory, Harvard University.

An Approach to Quantitative Forecasts of Precipitation—A. K. Showalter, U.S. Weather Bureau.

On the Significance of Correlations of Large Scale Circulations and Computation of the Correlation Coefficients—Irving I. Schell, Blue Hill Meteorological Observatory, Harvard University.

The Vertical Structure of the Atmosphere as Shown by Correlation Studies—G. W. Brier, U.S. Weather Bureau.

Pressure Changes Due to Vertical Motion—H. A. Panofsky, New York University.

ROTATING WING AIRCRAFT

7:30 p.m. **Room 401**

Chairman

R. H. Prewitt, Kellett Aircraft Corporation

A Direct Method of Calculating the Maximum Rate of Climb, Top Speed, and the Other Useful Performance Characteristics of a Helicopter in Powered Flight—Walter Castles, Jr., Georgia School of Technology.

The Response of Articulated Rotor Helicopters to Cyclic Blade Pitch Control—A. F. Donovan and M. Goland, Airplane Division, Research Laboratory, Curtiss-Wright Corporation.

Aerodynamic Instability in Unbalanced Lifting Rotor Blades—Reinhardt M. Rosenberg, Bell Aircraft Corporation.

FILMS

PV-2 Helicopter—Frank Piasecki, P-V Engineering Forum.

The Sikorsky Helicopter—Igor I. Sikorsky, Sikorsky Aircraft Division, United Aircraft Corporation.

Recent Progress on the Bell Helicopters—Arthur M. Young, Bell Aircraft Corporation.

METEOROLOGY, PART II

Session Prepared in Cooperation with the American Meteorological Society

Chairman

Charles F. Brooks

Blue Hill Meteorological Observatory, Harvard University

A Method of Preparing Prognostic 24-Hour 10,000-Ft. Charts—James E. Walsh, U.S. Weather Bureau.

The Collection and Use of Meteorological Data—S. P. Fergusson, Blue Hill Meteorological Observatory, Harvard University.

Transport Theory of Ozone Variation—Fred W. Decker, A.A.F., New York University; Conrad P. Mook and J. Richard Smith, U.S. Weather Bureau.